PUBLIC LIBRARY
OF THE
CITY OF DETROIT

Standard Size, 9 x 12. Price, Six Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE
AMERICAN MACHINIST PUBLISHING CO.,
256 BROADWAY, NEW YORK.

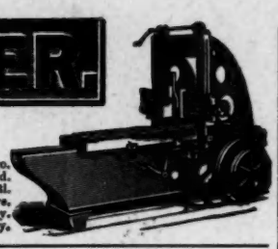
Some Leading Articles in this Number.

Explosion of a Brass Pump Plunger.
A Good Job Without Tools.
Making the Formula Fit the Case.
A Remarkable Job of Planing.
Motor Cycles in England.
A Public Supply of Compressed Air.
Doings at Backaway.
Action of the Shunt-Wound Motor.
Building a Great Dynamo.
Use of the Slide Rule.

NINETEENTH YEAR.

No. 25.
June 18,
1896.

THE GRAY PLANER.



MANUFACTURED BY
THE G. A. GRAY CO.,
CINCINNATI, OHIO.

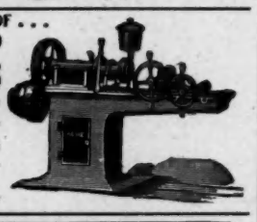
THE FOLLOWING MACHINERY MERCHANTS CARRY SAMPLES.

J. A. Fay & Egan Co., . . . 24 South Canal Street, Chicago.
Strong, Carlisle & Turney Co., . . 193 Bank Street, Cleveland.
E. A. Kinney & Co., ... 227 West 4th Street, Cincinnati.
Thos. R. Carey & Bros. Co., . . . 26 Light Street, Baltimore.
J. J. McCabe, ... 14 Dey Street, New York City.
Schuchardt & Schutte, . . Berlin, C., Germany.

THE ACME Machinery Co.

CLEVELAND, O.

MANUFACTURERS OF . . .
ACME BOLT AND RIVET HEADERS,
ACME SINGLE AND DOUBLE AUTOMATIC BOLT CUTTERS, cutting from 1-8 in. to 6 in. diam.
ALSO SEPARATE HEADS AND DIES.



MACHINE TOOLS.

63-INCH FORGE LATHE.

THE NILES TOOL WORKS CO.,

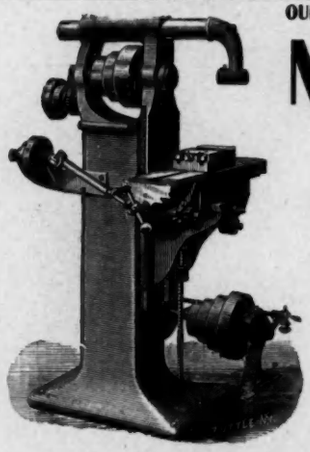
HAMILTON, OHIO. Correspondence Solicited.

William Sellers & Co. Incorp. PHILADELPHIA.

HAVE YOU EXAMINED ?

THE NEW TOOL GRINDER No. 2 ?
THE CENTRIFUGAL SAND MIXER ?
THE VICARS' MECHANICAL STOKER ?
THE NEW RESTARTING INJECTOR ?

These may be seen in operation at our establishment.
Descriptive Circulars Mailed on Application.



No. 12 PLAIN POWER MILLING MACHINE.

OUR LINE OF

Milling Machines

EMBRACES EVERY DESIRED SIZE AND STYLE.

UNIVERSAL—6 SIZES.
PLAIN POWER—10 SIZES, 4 STYLES.
LINCOLN PATTERN—3 SIZES.
DUPLEX—3 SIZES, HAND—3 SIZES.
VERTICAL SPINDLE—1 SIZE.

We Also Make a Large Variety of Other Machinery

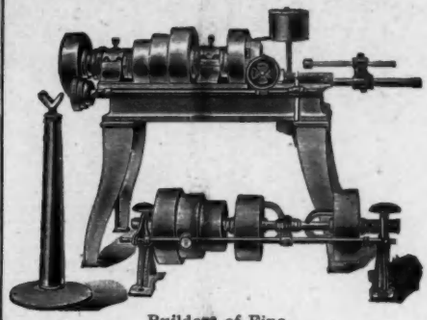
WRITE FOR CATALOGUE AND PRICES.

We have MACHINE TOOLS of ALL KINDS For Sale.

THE GARVIN MACHINE CO.,

Spring and Varick Sts., NEW YORK.
51 North 7th St., PHILADELPHIA, PA.

THE W. P. DAVIS MACHINE CO.



Builders of Fine

ENGINE LATHES,
From 12 to 30 inch swing.

UPRIGHT DRILLS,
From 10 inch Sensitive to 36 in., with B. G. and P. F.

ALSO

KEYSEATING and CUTTING-OFF MACHINES.

ROCHESTER, N. Y., U. S. A.

Send for Circulars and Photographs.

AN X RAY PHOTOGRAPH.

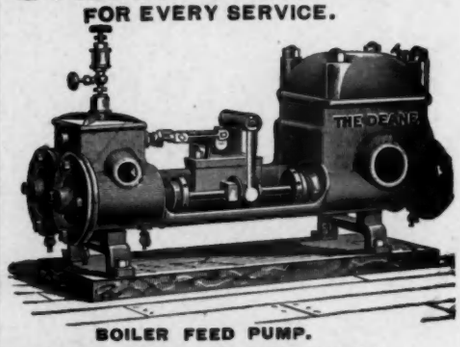
Crooke's Tube adds testimony to the $ in the Flat Turret Lathe. It is the coming type of manufacturing lathe. It cuts the cost without cutting the worker. It combines the convenience of engine lathe with speed and accuracy of a special tool. Special tools seldom required.

Jones & Lamson Machine Co.,

Springfield, Vermont,

Sole Builders and Sole Agents in U. S. A.

THE DEANE
OF HOLYOKE
STEAM PUMPS
FOR EVERY SERVICE.



BOILER FEED PUMP.

DEANE STEAM PUMP CO.,

HOLYOKE, MASS.

NEW YORK. BOSTON. CHICAGO.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

▲ ▲ ▲

NEW YORK, THURSDAY, JUNE 18, 1896.

VOLUME 19. ▲ ▲ ▲ NUMBER 25.

Explosion of a Brass Pump Plunger.

BY JOHN RANDOL.

A most unfortunate accident occurred at the South Brooklyn Steam Engine Works, Summit and Van Brunt streets, Monday the 8th inst., by which two workmen were very seriously injured. The South Brooklyn establishment has a large iron foundry, and a brass foundry which can turn out ten tons of brass castings daily. The victims of the explosion were Patrick Smith, aged 50 years, of 111 King street, and John Higgins, aged 30, of 63 Summit street, helpers in the brass foundry. The pump plunger which exploded was blown into fragments with a loud report; Fig. 1 is a reproduction of a photograph of one of the largest pieces found. It was, however, one of a pair of discarded marine pump plungers, and Fig. 2 is from a photograph of the duplicate. The material is a yellow brass. The size of the plunger was about 24 inches long by 6 or 7 inches diameter, with a threaded stem on one end, the body being cored and plugged; the least thickness of the fragment shown in the engraving is about 3/8 inch.

Fig. 1. A PIECE OF THE BROKEN PLUNGER.

Fig. 2. THE REMAINING PLUNGER.

This scrap plunger was too large to go into the melting pots, and Smith and Higgins, intending to break it up with sledges, placed it in the furnace shown in Fig. 3, and heated it, as they judged, hot enough to make it break easily, and then drew it out of the fire with tongs and laid it on the foundry floor near where the wheelbarrow stands in Fig. 3. What followed is told by James Sprowl, molder, as follows:

"When they took the plunger out I noticed it was hissing, and I said to one of the boys: 'There's a hole there, and those fellows may have an accident.' That was Albert Fairservice I spoke to. Then I passed by the men and spoke to them. They had the plunger on the ground, and Higgins was hitting it with a sledge hammer. He hit it one blow, and as it hissed I said to him: 'Don't fool with that; bore a hole in it.' 'Oh, I guess it's all right,' said Higgins, and he struck it again with the sledge and it blew up. I was standing ten feet away, behind a pile of iron castings. A piece of the plunger struck the castings and broke some of them. When I saw Higgins was going to strike again I threw myself on my face behind the castings, and I guess that saved me. The place was all in darkness after the explosion, on account of the dust that was raised. I found my way out, and then we sent the ambulance calls."

When the dust and steam cleared away, Higgins and Smith were found lying unconscious on the floor. Higgin's right leg was nearly cut off, and his left leg was broken in two places and otherwise severely injured. Both of Smith's legs were broken, and the flesh was mangled to such an extent that both were amputated at the Long Island Hospital, where he was taken

Fig. 3. THE SCENE OF THE EXPLOSION.

by the ambulance. Higgins was taken to Seney Hospital, where his right leg was amputated, and his injuries are such that he is hardly expected to recover.

Mr. J. H. Taylor, manager of the works, is reported as saying that the men had been warned not to use their hammers until the plunger had cooled off. The foreman of the foundry told me that he had heard one of his men say that he told the helpers to bore a hole in the plunger. The men were thoroughly experienced; but in spite of the oft recorded accidents caused by heating old pistons and plungers, they seem to have thought they stood in no danger, or else chose to take the chances, and did so with the deplorable results which followed. Both men are married and have large families, and no one can forbear the deepest sympathy for their miserable condition.

This paper has repeatedly printed stories of similar explosions, and it is well known that all closed hollow pieces of metal, working in either steam or water under pressure, are liable to become filled in the course of time with fluid, so that they will explode if sufficiently heated. In this case, according to Sprowl's story, there was a small opening to the cavity in the hot plunger, evidenced by the hissing of steam through it, as the plunger lay on the floor, just before it was sufficiently weakened by the second blow of the sledge to give way under the very great internal pressure of the steam. The broken edges of the fragment, now at the office of this paper, are discolored by heat, and the great violence of the explosion, which was more like the bursting of a shell filled with high explosives than the bursting of a vessel filled with steam, shows that there must have been a very great pressure in the plunger when it gave way.

The engravings are given, not to foster a morbid taste for the horrible, but to accentuate the lesson which the story of this explosion teaches. It is wrong for workmen and their superiors to permit the heating of any pieces of old machinery supposed to contain a closed cavity, without first boring a small hole in the piece. Cases have been known where violent explosions have followed the heating of hollow pieces which had no known means of filling with water, and it seems quite probable that oil was the material which caused the disaster. In any case, no matter what the size, shape or history of a piece which is hollow and has the hollow closed up tight, it must not be heated for any purpose, nor to any degree, without first boring a hole into the cavity; otherwise there is always risk of loss of life or limb and destruction of property. Steam pistons and pump plungers are especially dangerous parts of old machinery to put in the fire before venting.

Certainly, no reader of this story of the lamentable occurrence at the South Brooklyn Steam Engine Works who has a single grain of common sense, or is at all fit to have charge of workmen, will ever permit the heating of a hollow unvented piece of old machinery by men under his control. Let this lesson be fully understood, and constantly remembered: Any piece of old machinery, no matter what, so long as it has a closed cavity in it, can be heated only at the risk of accident. It may look silly to insist on drilling a small hole in every hollow piece, not already fully open to the atmosphere, before heating it; in ninety-nine cases out of a hundred the precaution may be needless, and the hundredth case may be that of the South Brooklyn pump plunger, and cause a horrible accident. The wise man is overcautious rather than foolhardy; and had Smith and Higgins relied less on past escapes from harm, and more on the not too apprehensive caution of their fellow-workmen, they would not now be in their frightful condition.

If a piece is hollow, bore a hole in it before heating it or putting it into a foundry cupola. Make this the fixed rule of your work and your establishment, and allow no deviation from it under any circumstances whatever.

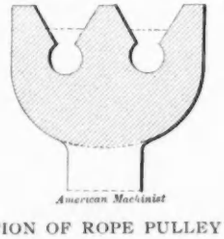
▲ ▲ ▲

A Good Job Without Tools.

BY T. HODGSON.

I have often been very much interested in what some of your contributors have given under the heading of "Shop Kinks," and in the ways that others have given of doing jobs for the doing of which the shop or mill seemed to have no adequate provision. Believing that such matters may be of interest to others of your readers, I offer you two or three instances of this kind that have fallen under my observation or have occurred in my own experience.

In the winter of 1885-6 I made a call at the foundry and machine shop of Clish,



SECTION OF ROPE PULLEY RIM.

Crow & Co., of Truro, Nova Scotia. They had got an order for eleven double-grooved wire-rope pulleys, 10 feet in diameter at the bottom of the groove. The hub was something like the hub of a bicycle, 18 inches long, and the flanges were 15 inches in diameter. The arms were of 1 inch round wrought iron, cast into the rim, and alternating or staggering between the two flanges, like the spokes in a radial bicycle wheel. The section of the rim was to be about as shown in sketch, and the sloping sides, as well as the circular part at the bottom, which was about 1¼ inches in diameter, had to be finished, and the hubs had to be bored to 4½ inches. When done, the bottom part of the groove had to be filled with rubber, which they got in pieces 18 or 20 inches long, and of such cross-section as to fill the circular part of the groove and to extend out between the sloping sides about as far as to where I have drawn the faint dotted lines. The rubber sections were large enough to drive in very tightly.

The casual observer going into this establishment would not say that it was just the place to get this done. The molding, blacksmith, machine and pattern shops were all supplied with machines and appliances fully equal to what would be found in any general job and repair shop employing all round, say, 35 to 50 men; but the foundry was small and there was not in the place a lathe or boring mill that would take in half the diameter of these pulleys. The boring looked impracticable and the turning impossible. If the Roentgen ray would have been able to point out the possibilities that lay undeveloped within the convolutions of the blue-nose gray matter around the shop, it had not then been discovered; but they were there, and were promptly developed into actualities. The hub was rammed up in a 3-part flask, with the partings at the edges of the flanges, notches being cut in the flask at the partings to allow the arms to be set in. A spindle was set up in the center of the hub for a sweep, and the rim was swept in a circular heap of sand on the floor, not held by a flask, and entirely separate from the flask containing the hub. The arms were put in place; dry sand cores were set, in sections, for the grooves, and others to cover the whole mold of the rim. These were then covered with green sand, the core was placed in the hub, and all was ready for the melted metal.

When cast, these pulleys weighed about 3,100 pounds, and were as smooth, clean-looking castings as one could wish to see. They were trammed under a heavy suspension drill, and bored with a boring bar supported above and below the hub.

A rectangular pen, about 11 x 3½ feet inside, was built up on the shop floor, of timber 14 or 15 inches square and, I think, three timbers high, and the floor was taken up inside of this pen to let part of the pulley drop down through it. These timbers were halved together at the corners and solidly bolted together. A mandrel with bearings turned down at the ends, so as to make shoulders to take up end play, was driven into the pulley, and the whole was mounted to run in boxes placed midway on the sides of the pen. The rim of a large spur gear was now clasped to the arms of the pulley just inside of the rim, and a small pinion matching this gear was fitted onto the spindle of an engine lathe. The whole headstock was taken from the lathe and bolted to the top of the timber in such position that the pinion would work in the large gear, and so turn the pulley at any required speed and with plenty of power.

A very heavy slide rest was bolted to one of the end timbers, so that the lathe tool it carried would be, when in its work, only a few inches from where the power was applied to the pulley. When I was there the slide rest was swiveled around parallel to one of the sloping sides of a groove, and the feeding was done by a star and kicker.

The tool was taking a good, practical business cut, and there was not to be seen the least sign of spring or chatter, which, no doubt, was because the cut was taken so close to where the power was applied. I do not believe that any high-class pit lathe, costing several thousands of dollars, could, on this particular job, beat, either in quantity or quality, the work that was being done on this rig, improvised at a cost of certainly not over $50 or $60.

Mr. Clish, the manager of this concern, now known as the Truro Foundry & Machine Co., tells me that since that time they have made a large number of similar pulleys, some with one and others with two grooves, and some as large as 12 feet in diameter at bottom of groove, and with shafts 8 inches diameter.

The first lot of these pulleys described, the eleven, were used to convey power nearly a mile, to run the hoisting, crushing, and amalgamating machinery of the Dufferin Gold Mining Co., Salmon River, Halifax Co., Nova Scotia, and the rest have been used in connection with either coal or gold mining in that country.

▲ ▲ ▲

Making the Formula Fit the Case.

BY C. L. REDFIELD.

When a man orders a suit of clothes, the measurements of his body determine the proportions of the garments; but when he orders the clothes under which he is to sleep at night, the size is not dependent upon the circumference of his waist. Bed-clothes are determined by the general proportions of human beings, and not by those of a particular person.

Ordinary formulæ stand in very much the same relation to the objects to which they are to be applied that the measurements of a man stand to these different kinds of clothes. The formula for the bursting force of a fluid under pressure may be used in one way when applied to determine the proportions of a gas bag, but it must be used in a different manner when determining the proportions of a steam cylinder.

The real value of a formula lies in the fact that it may be used as a base of operations or a starting point. It is generally more important that a man should know approximately the result of his formula than that he should know it accurately. That he may know it approximately, or find it out with ease, it is desirable that all formulæ be in their simplest possible form, or that he have some variations of the ordinary formulæ composed of round numbers, that are easily remembered and may be worked mentally.

Such a formula as "A pint is a pound" is very easily remembered, and has its value, especially if one remembers that a gallon of water weighs 8⅓ pounds, and has some idea of the specific gravity of the substance to be weighed or measured. With this very simple formula firmly fixed in his mind, the engineer may determine approximately a great variety of dimensions in less time than he could reach for his reference book. As every engineer determines more things tentatively than he does finally, the saving of time is very important to a man who has many things to attend to.

The formula for the weight of round iron, given by Mr. Bowen in the "American Machinist" of May 21st, is a very neat example of these easily remembered formulæ. Another one very similar to this is—"Multiply the number of teeth in a gear by the number of thirty-seconds in the pitch, and point off two places;" the answer is the diameter. While this is not strictly accurate, there are a number of concerns which furnish cast gears made according to this formula. Five hundred pounds per inch of pitch and width for the strength of gear teeth, and 1-inch shaft, 100 revolutions, 1 horse-power, are other examples of condensed formulæ.

It has become quite common to see the merits and advantages of the slide rule and calculating machine advocated; and while I could easily mention a number of places where it would pay to use them, I do not think that the hands of the practical engineer is one of these places, or at least, those of the engineer who busies himself getting up special appliances to meet peculiar conditions. I am one of those persons who believe in making every tool do its utmost work and in having none around that can be dispensed with. Most of the calculations of an engineer consist in using formulæ; and if he has these in such a simple form that they can be used mentally, or with the aid of a few strokes of the pencil, it is a sheer waste of time to make elaborate and accurate calculations that are not needed.

There have been any quantity of pencil-sharpening devices made, but they have no steady sale. Everyone has a knife, and no one has enough pencil-sharpening to be bothered with an extra device for the purpose. The same is true of an engineer who has frequent use for approximate calculation and only occasional use for exact calculation. For him, a table of logarithms serves every purpose; because it is convenient when he wants it, and is not in his way when he does not want it.

Another thing much extolled is the section-lining instrument. The use of this is to enable the draftsman to make uniform section-lining and the only reason that I can see for a draftsman to be bothered with such an extra instrument would be because he could not make uniform spacing without it. I am very much of the opinion that a draftsman who cannot space his lines uniformly enough to be presentable without the use of such an instrument, should seek some other business better suited to his abilities. The designing of machinery is very largely dependent upon the eye for the proportioning of parts, and a man whose eye is not well enough trained to enable him to make comparatively uniform sectioning over a large area cannot depend upon it for intelligent service in designing. Furthermore, the act of section-lining without the aid of spacing instruments is a valuable, though unconscious, training of the eye in the very art in which it is most needed in designing. The more of this kind of training the eye can get, the better the man will be as a designer, and an instrument which takes away this training without contributing anything of importance is a detriment rather than an advantage.

▲ ▲ ▲

American Machine Tools in Russia.

Mr. Walter F. Dixon, chief engineer of the locomotive department of the Sormovo Works, Nijni Novgorod, Russia, is again in this country for the purchase of equipment for his department of the above-named works. The works already employ 5,000 men in the production of steamboats for the river Volga, and railroad cars, both freight and passenger. The locomotive department is to be a new addition to the works, and is to have a capacity of 150 locomotives a year. The department is to be organized on the American plan, although the locomotives turned out will be, for the present at least, of the European type. It is quite possible, however, that the large number of engines which have been recently sent to Russia by the Baldwin Works, will do missionary work and lead to modifications of practice in the future. The buildings and equipment are to be of the most modern character, and we understand that orders for the outfit have already been placed with American builders—Philadelphia houses taking the lion's share. The superintendence of the works is also to be in American hands—the foremen of all departments being American.

In the course of his inquiries, we understand that Mr. Dixon obtained prices for his equipment from American, English and German builders, and it is interesting to know that between the American and English prices there was but little difference. Individual machines differed, of course; but, taken as a whole, the bids from the two countries were practically the same. German prices were materially lower, but the German tools were not considered to be as well adapted to the work.

The entire equipment is to be shipped early the coming fall, and active locomotive building will commence at once on its arrival and installation.

Drawings of Stationary Engines.

We give herewith plan and elevations with one or two details, reproduced on a scale of ¾ inch to 1 foot, or one-sixteenth size, of a 6 x 9-inch horizontal stationary engine—a plain slide-valve throttling engine, such as any machinist can build in any shop or repair when necessary, and such as any man of common intelligence may soon learn to run. We have seen also a set of the working drawings for this engine, comprising all necessary details and dimensions for their construction. The designer, Mr. Otto E. Evans, of York, Neb., has prepared sets of drawings for this style of engine in four different sizes, 3 x 5, 4 x 6, 5 x 8 and 6 x 9-inch, and proposes to furnish blueprints of any or all of them, with other sizes and styles to follow.

▲ ▲ ▲

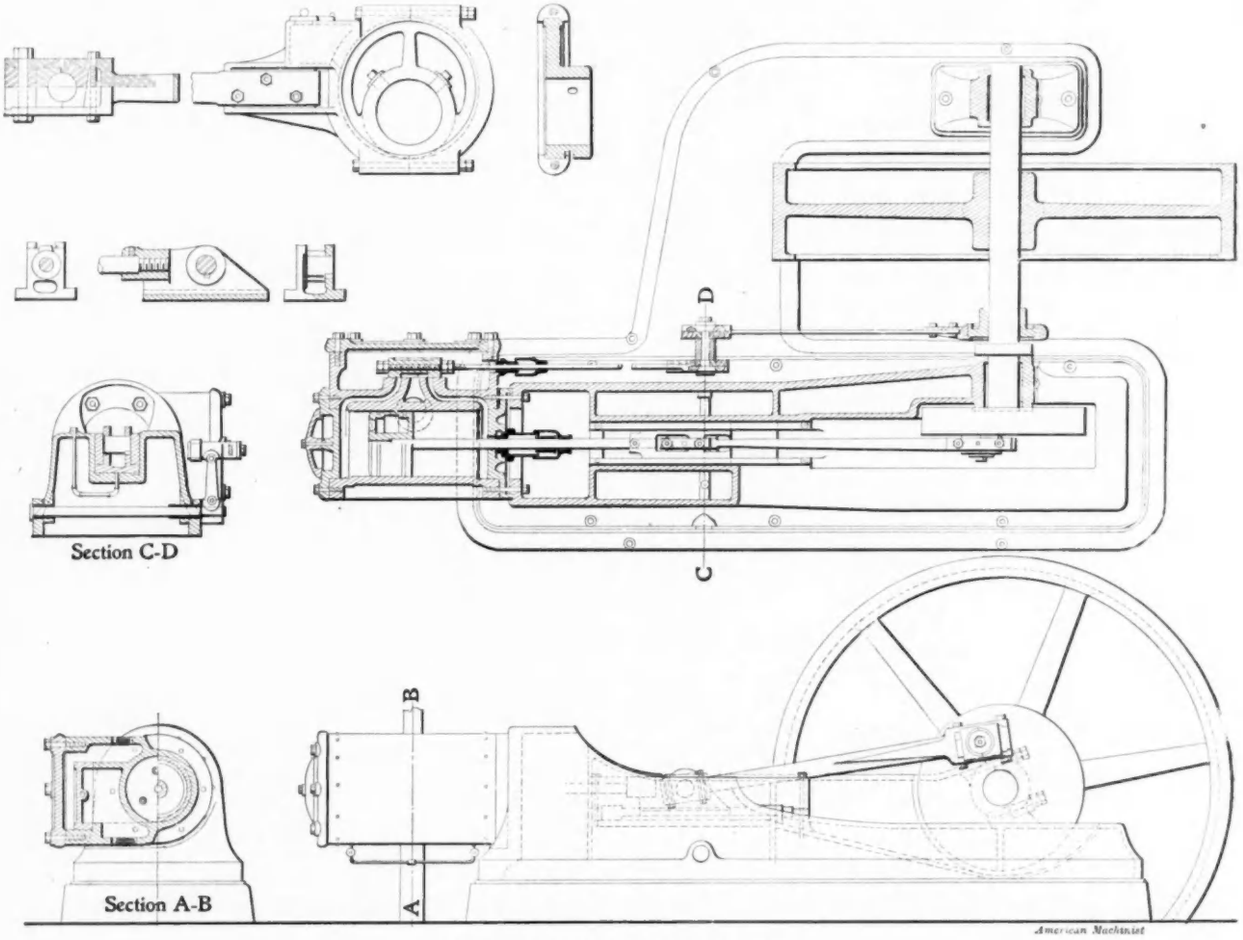
We find in two of our English contemporaries, the "Engineering Review and Metal Worker" of May 20th and the "Iron and Coal Trades Review" of May 29th, reproductions of our illustration of a hydraulic governor for rolling-mill engines, devised and used at the Pencoyd Iron Works, Pencoyd, Pa. These articles are published by our English contemporaries without credit, and as though they were original with the journals named, which seems scarcely to conform to the ethics of the case.

▲ ▲ ▲

Professor Wm. T. Magruder sends us a pamphlet which has been issued, setting forth the attractions to be offered by the Tennessee Exhibition, to be held at Nashville next year.

▲ ▲ ▲

Make up your mind now to take your politics coolly this campaign, and endeavor to keep the other fellow as cool as possible; thus all will be more comfortable, and the country will be saved just the same.



A 6 x 9-INCH HORIZONTAL ENGINE.

Uses and Advantages of a Public Supply of Condensed Air.

BY FRANK RICHARDS.

Lifting or Forcing Water by Direct Air Pressure.

We have seen that where pumps of any kind are used for forcing water against a pressure, and where it is necessary to maintain a pressure upon the water, so that it will flow into the upper stories of high buildings, or so that it may be used to operate presses or lifts, or to flow with force from jets wherever it may be required, the pressure may be supplied and maintained by simple connection with the air main, instead of depending, as heretofore, upon gravity, and requiring a high tower or an elevated tank or reservoir for the purpose.

When we have arrived at this point it is very natural to inquire, since the air can do so much, why it may not do the entire work; and indeed it can perform the service in excellent fashion without the employment of any pump or machinery. We can have a very practical illustration of the way that this may be made to work. In the building where I happen to be writing, the flat part of the roof is about 210 feet above the street level. A tank might be placed upon the roof, and if it was filled with water, and pipes were led from it through the building, every room would have its water supply as long as the supply in the tank was maintained. With the height of 210 feet, the pressure at the street level would be about 91 pounds, becoming gradually less for the successive floors upward.

Now, suppose that instead of the tank on the roof we have two closed tanks on the ground floor, with all the necessary air and water pipe connections. We start with both tanks filled with water from the city water main or any other source of supply, and we assume that the connection

with this source of supply is shut off, while communication is opened with the water-pipe system of the building. We now turn the air pressure of 100 pounds upon the water in the tank, the air pipe preferably connecting with the top of it, and this pressure is at once realized throughout the system, varying with each floor level, but still equally operative and somewhat in excess of the pressure formerly realized from the tank on the roof. This water may be drawn off anywhere, as it may be required, and as fast as it leaves the tank the compressed air enters and replaces it. When by this operation the tank is emptied of water and is full of compressed air, the connection with the air supply is closed, and communication is made with the atmosphere instead, while at the same time the tank is shut off from the water-distributing pipes and is opened to the water supply, and at once begins to refill with water. While these changes of pipe connections have been made on the first tank the necessary changes of connections to the other tank have been made simultaneously; and while the first tank is now being refilled with water, the second continues the work of supplying the water under pressure to the building. By means of floats in the tanks and suitable valves and connections, the entire operation of pressure maintenance and water distribution may be made completely and reliably automatic. Indeed, there are already on the market a number of apparatus operating practically as above described. The most common form consists of a single chamber which is alternately filled with liquid and then emptied by the ejection of this liquid under air pressure. This arrangement, although perfectly automatic, is of course intermittent in its action, but there is no reason why two of them might not be operated in connection and a constant pressure maintained.

When the compressed air is employed in this way, it is not a difficult matter to compute the amount of air used and the cost of it. The arrangement would have the advantage of the entire absence of machinery, with the first cost of the same, and also the cost of operation, supervision and maintenance. The disadvantage would be in the somewhat larger air cost than if the best possible style of air-operated pumps were employed, as no use would be made of the expansive action of the air. The air cost would, however, be certainly less than if any of the common styles of direct-acting steam pumps were employed and operated by the air. For any volume of water received into the tanks and forced from them, an equal volume of air under full pressure would be used, and the same, whether the water were drawn off at the lower or the upper story.

A cubic foot of water contains 7.48 gallons, and the cubic foot of air at 100 pounds pressure and normal temperature equals 7.8 cubic feet of free air at the same temperature. We add 20 per cent. to the air used, which will be liberal to cover the possible losses, and we then have: $7.8 + 1.56 = 9.36$ and $9.36 \div 7.48 = 1.25$. This 1.25 cubic feet is the volume of free air used for every gallon of water forced through our 200-foot high building, and as the cost of our air is $0.05 per thousand feet of free air, or $0.00005 per single foot, the cost per gallon of water will be $1.25 \times \$0.00005 = \$0.0000625$ per gallon, or $0.0625, six and a quarter cents, per thousand gallons.

With the same air supply, if the water was used under a lower pressure, the air might first pass through a pressure reducer, and the air consumption and cost would be proportionately reduced. As the action would be slow, or certainly very different from that of using the air in a motor or engine, and as the air would also be in contact with the water, there would be no loss from the fall of temperature upon expansion. If the water pressure was only wanted to be equal to a head of, say, 100 feet, the air pressure required would be 43.4 pounds, or, say, 4 atmospheres, instead of 7.8 atmospheres, and the air consumption and cost would be in the same ratio, or only a trifle over one-half of that required for the higher service.

Even if the city water pressure is sufficient for the ordinary, everyday uses, and capable of flowing wherever it may be required, the presence of this compressed air might still be valuable for occasional or emergent use, and especially in case of fire. With a tank filled with water, or, still better, with two tanks and a large water supply pipe for rapidly filling, if the air pressure were turned on, the water might instantly be thrown with force and in sufficient volume to extinguish almost any incipient fire. Service of this character might easily be provided for, not only for single buildings, but, by arrangement, for groups of contiguous buildings or for whole blocks, and the means of fire extinction could be made much more quickly available than with the very best of fire engines and the most alert firemen.

▲ ▲ ▲

Competition for Motocycles.

Our contemporary "L'Industrie," an illustrated technical and industrial journal of Belgium, proposes to organize for the Exposition to be held next year in Brussels, a competition of horseless carriages. This is to be conducted upon lines more scientific than the mere races which have taken place in France and America, and is to consider the technical principles, construction and operation of the various motocycles. Some preliminary broaching of this subject by "L'Industrie" has resulted in such warm encouragement that it is proposed soon to issue a program indicating the general lines of the competition.

Motor Cycles in England.

BY W. H. BOOTH.

There is every appearance at present that the question of mechanically propelled road vehicles will soon be one of great prominence in this country. I have previously pointed out the limitations under which we have labored. In the first place, no mechanically propelled carriage has been allowed to travel at a speed of over four miles per hour; and secondly, it has been necessary for a man carrying a red flag to walk a certain number of yards ahead as a warning. In spite of this, and because of this also, we have seen a growth of the heavy traction engine, suited to haul heavy loads at a slow speed. Though so hampered by legal enactments, these traction engines are used to the number of 7,000, or one for less than every three railroad locomotives. But the new movement is almost wholly given to lighter vehicles for passenger purposes. The several trials in France of gasoline vehicles have given a great impetus to the motor car generally, and there have been several small exhibitions of them here, and there is one now in progress at the Imperial Institute, where not only gasoline motors are shown, but also electrical. No doubt, at present, for lightness and endurance, the gasoline motor holds the field for country work, but I very much doubt if it will do so in the cities.

It would scarcely be thought safe to allow gasoline motors using low-flashing-point oils, or rather spirits, to run about in London, because of the risk of fire. With the electrical car there is no risk. A vehicle of four wheels at the Imperial Institute, and with a seating capacity for four, does not, after all, weigh anything very much—perhaps a matter of 1,500 pounds. The accumulator cells which furnish the necessary energy are not filled with liquid acid liable to spill about and become a nuisance, but simply with some porous and absorbent powder which surrounds the leaden plates closely and is saturated with acid. The cell can be turned upside down with perfect safety, and the car seemed to be capable of very good control, turning in its own length and running fast or slow at the will of the driver. The accumulator will store current sufficient to run forty miles, so that the car could always run between town and town wherever there was an electric light station. Indeed, in a country like this, where towns occur in the crowded centers from two to five miles apart, and in the country rarely more than ten or fifteen miles apart, the problem of day load for electric light stations will be to some extent in process of solution should the electrical carriage come much into use. At present the one great difficulty to overcome is that of the cells. Ordinary accumulator cells cannot be discharged at a rapid rate with safety to the plates. What is wanted is a cell that will discharge much

more rapidly, so that a given weight of cell will turn out energy in a shorter time. Thus equipped, a car would carry a much less load of cells in the proportion of the greater rapidity of discharge. It could not, of course, run so far on a charge, but that would perhaps not matter very much.

If we assume that, on an average, the use of a horse adds 100 per cent to the length of a vehicle it follows that the streets would be able to accommodate double the present traffic when the horses were removed, and that alone is an item deserving of serious consideration in places like London or New York, where traffic is simply a continuous procession of vehicles. There is, however, one important point that is usually overlooked, and that is, that it is far easier for a horse to follow its own nose than for a man to guide a vehicle by means of any mechanical gear. A very considerable degree of skill is required to drive a motor vehicle, or rather to guide it properly, whereas a horse is an animal of some intelligence and requires no skill to guide it. At slow speeds the guiding difficulty does not amount to much with the motor, but at higher speeds the lateral departure for a very slight angularity of front wheels is rapid and demands close attention. In driving a horse, all attention is concentrated on the horse at one point through a single medium. In driving a motor car, the mind has to attend to two distinct mechanisms—one through the left hand, namely, the regulating of the forward motion; the other through the right hand, namely, the guiding mechanism. The most apt to acquire skill in the double art will probably be people who have been accustomed to use both hands upon different and distinct operations. A pianist, who has to employ two hands upon hammering out sounds depicted on entirely distinct lines, ought to be quick to acquire the requisite skill.

The popular imagination is being inflamed as much as possible, and a good deal of money will be squeezed out of the public for rotten enterprises in connection with motor cars. As an example of what is being attempted, Mr. Pennington is here and is figuring largely in an advertisement for an ærial torpedo to drop dynamite about in an unpleasant manner. There is a picture of a flying torpedo in an engineering paper, in full operation, the inference being that the thing is already accomplished. I fear Pennington is trying to work off his double-spark business for all it is worth, and there is such a lot of idle money that any wildcat scheme to promise a fortune gets support; but it is as difficult as ever to get support for genuine paying undertakings, requiring only ordinary business push and attention to yield really good dividends.

London, Eng.

De LaVergne Shops Screw Planing.

BY JOHN RANDOL.

The Leavitt Chelsea pumping engine valve motion has a shifting cam action, one detail of which is a very quick pitch screw surface cut on each side of the cam shaft; to these two flat screw surfaces, shown in Fig. 1, bronze shoes are fitted which may be described as nut sections. These nut sections have substantial rectangular ribs cast solid on their outer surfaces, and these ribs slide in lengthwise slots in the valve-actuating cam hubs, the spiral-cut shaft, nut-section shoes and slot-hub cams being so arranged and combined that, if the rotating shaft is moved endwise, the action of the quick-pitch spiral cuts in the shaft will cause the valve-actuating cams to have an advancing or retreating rotary movement on the cam shaft, which alters the time of cut-off by hastening or delaying the cam time. The cutting of these screw faces on the cam shafts is a job to think about.

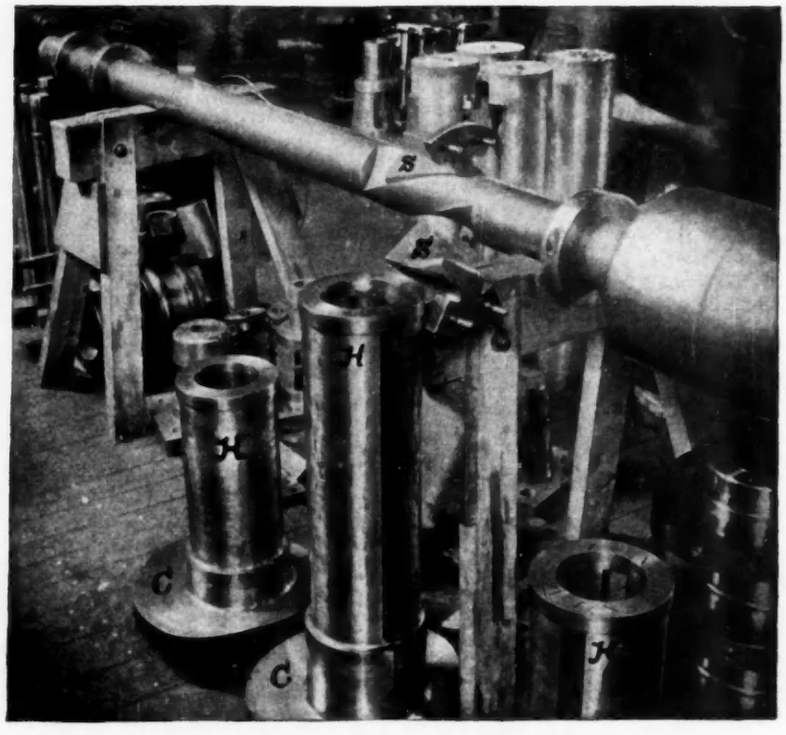


Fig. 1. CAM SHAFT SCREW AND SHOE.

The pitch is in one case, and possibly in all, 120 degrees twist in 18 inches of shaft length. The cams, shown in Fig 1, are heavy, and they have some work to do—maybe a good deal. I did not examine the drawings to see what form of valves are moved by them. There are several of these spirals to cut for each engine; they must lie exactly 180 degrees apart on the shaft, and they must be true to pitch. The pitch is so quick that the compounded movements required to produce it give a much greater tool travel in the axial than in the circumferential direction; hence the job is nearer planer work than lathe work, and yet it is a good long way off planer lines, and the longer one looks at the job the more it appears to be pretty much outside of the movements of every known tool except, possibly, a big gun-rifling machine.

Mr. Blevney, superintendent of the De La Vergne shops, was well aware that the perfect fit of shaft spiral and nut section could be easiest reached by adopting some form of tool by which both the spiral and the nut-section surface which fitted it could be finished, which very much complicates the problem, and makes a really beautiful mechanical riddle, the correct solution of which is not to be guessed without some study.

Mr. Blevney's method of planing exterior and interior screw surfaces to exactly fit each other is shown in Figs. 2 and 3. His idea is to mount a revoluble sleeve in journal boxes on the planer table, the hole in the sleeve being large enough to take the cam shaft through it, and the sleeve also being flanged at the end nearest the planer cross-rail, so that a fixture, adapted to properly locate and securely hold the nut section, can be bolted to the sleeve for use when the nut sections are to be finished, and give this flanged sleeve a rotating motion derived directly from the planer table travel.

There is another perplexing condition: Not only is there a rectangular rib or feather on the back of each nut section, but the nut sections are confined on the screw faces cut in the rod solely by the

internal surface of the cam-hub bore, and hence the outer surface of the nut section must exactly fit the bore of the cam, or, which is the same thing, must exactly continue the cylindrical surface of the cam shaft when the nut section is in place on its screw seat in the cam shaft. This makes three forms of surface to be finished on the nut section—a straight rectangular form for the rib, which is a regular planer cut; an external cylindrical cut, covering all the outer surface not occupied by the rib, and the screw surface of the side opposite the rib. Of course, all of these three different kinds of cuts should be made at one setting of the nut section, without moving it in any way, as they may then be expected to be correctly located in relation to each other. In Fig. 1, one nut section is shown in place on the cam shaft, and one lies, the other side up, on top of the horse in front of the shaft; these sections are marked *S*, and it will be observed that they are cast with holding feet; these feet are tapped and fitted with studs, and in Fig. 3 the nut section *S* is shown held in the spiral fixture *F* by the stud-nuts *N*. The holding feet of the nut sections are cut off after the whole job is completed and scraped in on the cam shaft. It is obvious that the nut section must be held in a fixture which is located by the outer surface of the cam shaft while the scraping is done; otherwise the fitting would be sure to put the rib on the back of the section out of line, and so make a slack fit of the rib in the cam-hub slots, which would never do at all. It is also obvious that this fitting fixture, which slides on the shaft while the section-fitting is in progress, should by all means be the same one which holds the nut section while being machined on the planer; hence the planing fixture is carried out in two twisted arms which unite in a bored ring at the left end of the fixture *F*, Fig. 3. This gives the fixture *F* the general form of two substantial bored collars united by two twisted arms,

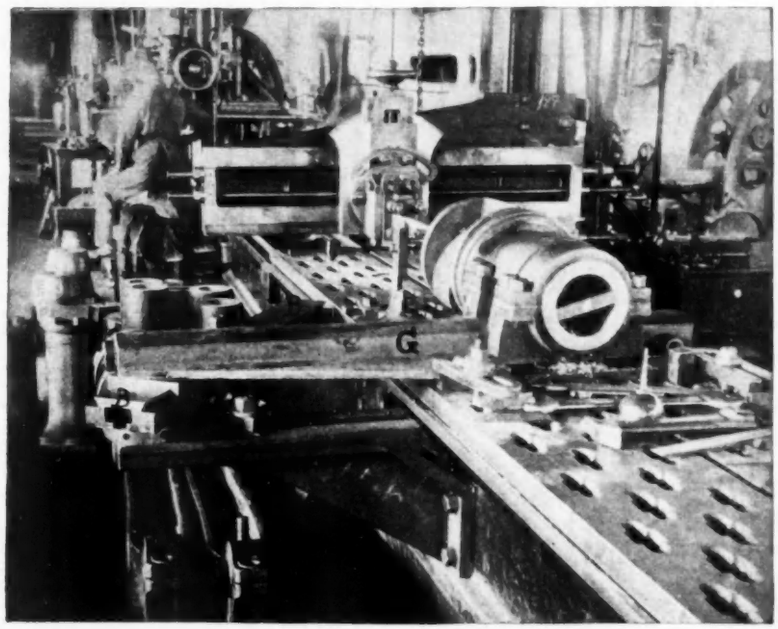


Fig. 2.

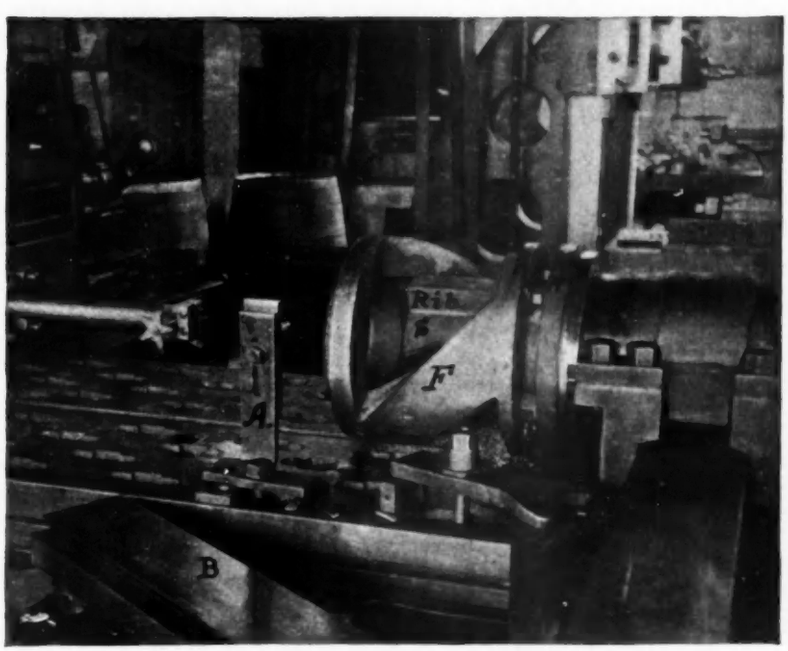


Fig. 3. SCREW PLANING IN THE DE LA VERGNE SHOPS.

a piece easy enough to look at, but an awkward thing to describe.

The general form of the sleeve-revolving mechanism is the same as that of a rifling machine—the sleeve has a ring of gear teeth meshing in a driving rack; this driving rack is guided by the long covered way *G*, Fig. 2; the left-hand end of this rack is bored to take a vertical stud which is solid with the sliding block dovetailed to the top of the adjustable pitch bar *B*, Fig. 2; the pitch bar is secured to horizontal T-grooved brackets bolted to the side of the bed of the Deitrich & Harvey open-side planer, on which this job of unusual work is done.

The rack and pinion and pitch bar give the rotary motion to the sleeve as the planer table travels, and enable the outside circular part of the nut section to be planed to fit the cam-hub bore, and the nut-section rib can be planed without rotating the sleeve. The screw surface of the nut could be planed with a long tool to reach in through the bored end of the fixture, were it not that the rotation of the nut section would cause its body to interfere with tool shank in all tool positions except where the tool stood in the middle of its crosswise cut. Therefore, it was necessary to make a round tool slide body with a T-end bolted to the planer buckle, and a little cross-slide at its outer end fitted with a saddle, tool post and star-actuated feed screw of its own, all as shown with tolerable clearness in Fig. 3. The star feed is actuated by a stud in a vertically adjustable slide in the upright *A*, Fig. 3, strapped to the planer table. At first sight this little cross-rail and tool saddle do not seem necessary; but a moment's reflection will show that the largest tool support possible is a stationary cylinder of less diameter than the thickness of the metal of the cam shaft between the two screw surfaces which shift the valve cams. These cams are shown at *C C*, Fig. 1, the slotted cam hubs being marked *H*. The slots can be finished by planing, as the hubs are made with loose ends secured with filister screws, as shown.

ELECTRICAL MACHINERY.

Building of a Great Dynamo.—VIII.

Referring again to the special driller for drilling the stud holes in the center magnet and radial magnets, Figs. 30 and 31 give some idea of the general construction details of this machine. The revolving table *T*, Fig. 31, does not give abundant supporting surface for so heavy a piece as the 10-ton center magnet, and the designer who intends to bore four large holes at the same time in steel must be careful to provide a powerful feed action, and to put the pressure as nearly as may be in line with the resistance. Some changes were made in this tool before it was really efficient, and these changes were in the lines indicated. Ten tons is a heavy weight, and is not easily revolved on a small turn-table, and it takes a great deal of power to force four big drills into steel.

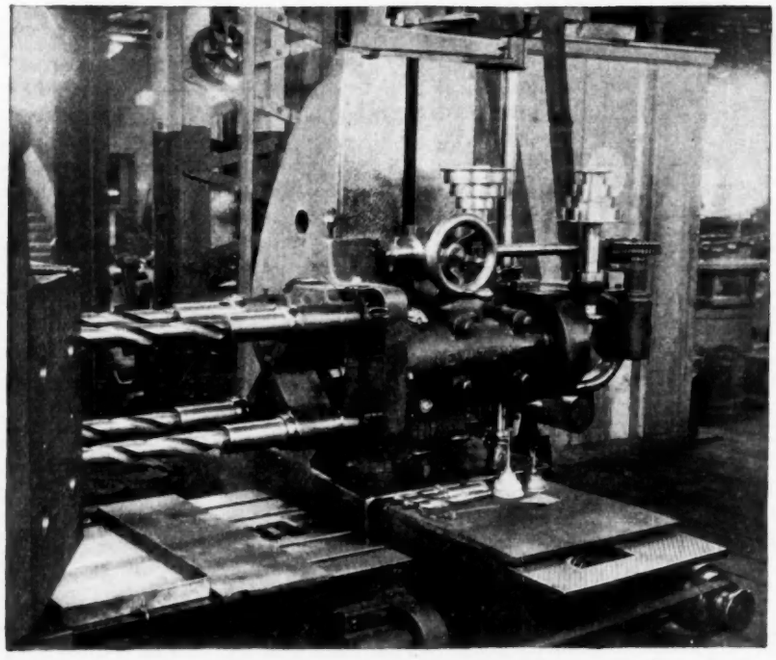


Fig. 30. MAGNET-DRILLING MACHINE.

The radial magnets and magnet caps are shown in Fig. 32. The magnets come from the steel mill finished by milling to the outside round-cornered cross-section shown. This is not a very close measurement, as the "boxes," or magnet casings slip easily over these radial magnets. It is, however, essential that the radial magnets should be a very good surface fit on the center magnet, and also that the magnet caps should touch the ends of the radial magnets at as many points as possible, in order to reduce the resistance to the flow of magnetism, and the radial magnets should also be very nearly the same length. The special double-face mill, Fig. 33, was built to finish both ends of the radial magnets at one passage between them.

The large cast-iron cup-shaped mill bodies on this machine are about 30 inches diameter; the mill spindles are about 6 inches diameter, and the working ends of the cutters are 11 or 12 inches outside of the supporting journal. There are 30 cutters or teeth, each about $\frac{9}{16}$ inch square, in each mill. Each tooth passes through a square mortise in a cylindrical tool-holder which is carried on inward through the wall of the cup-shaped mill body, and is threaded to take a hexagon nut inside the cup; the cutters lie in seats cut in the outside enlargement of the cup at its open end, and are simply plain pieces of square tool steel. These details make a very cheap inserted tooth mill; the teeth are firmly held, and quickly taken out and put back, as has to be done when the teeth are ground. When replaced, each tooth is held against a fixed stop while the nut on its holder is being screwed up. Teeth set in this manner never come quite even; but, with a fine feed, a narrow flat on the end of the tool farthest in advance makes a smooth surface on the work. The feed used on this machine is from $\frac{5}{8}$ to $\frac{3}{4}$ inch per minute, and only a very light cut is taken; as both ends of the radial magnets are finished at once they must be parallel, and the surface produced with the fine feed and light cut is so smooth as to be scraped to a finished flat face with but little labor. There is always the diameter of the mill to be added to the linear surface finished by an end mill, because all the mill teeth must pass completely over the milled work; hence, with 30-inch mill and a $\frac{5}{8}$-inch feed, as in the present case, the last tooth passes the finished surface 48 minutes after the first tooth leaves it, and 48 minutes after the work might be finished were it not for the small cut always taken by the following teeth.

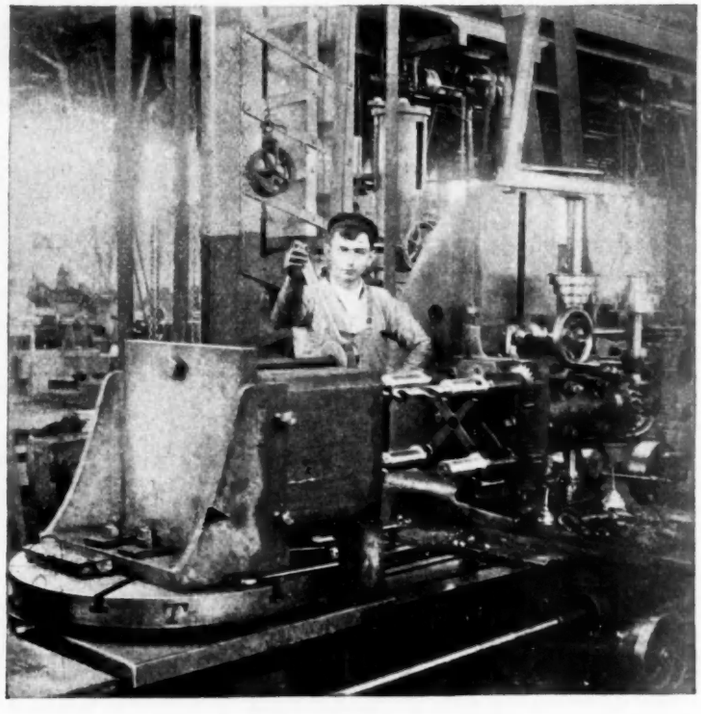


Fig. 31. MAGNET-DRILLING MACHINE.

But in spite of this drawback, the end

mill is the only tool suitable for such a job as the parallel ends of the radial magnets, as it is the only tool which makes a flat surface, and two end mills come nearer to certainty of producing flat and parallel surfaces on the two ends of the same piece than any other tools we have at present. It is very difficult indeed to put a lot of these radial magnets on a planer table, "side down" the ends and

Fig. 32. RADIAL MAGNETS AND CAPS.

bring the finished ends parallel, and it is equally difficult to center the magnets and face the ends in the lathe. The lathe would bring the ends parallel, but is not sure to make the ends flat, or bring the magnets all to the same length.

Other methods of finishing the radial magnet ends have been tried in the Siemens-Halske shops, but the machine shown in Fig. 33 does better than anything else so far used. This double-face milling machine is also used for milling the center magnets of smaller dynamos; but it has not nearly capacity enough to take the large center magnets between the mills. The radial magnets are quite large, as will be seen from Fig. 32, where the figure of a workman is introduced. They are finished all over outside and have six holes drilled all the way through each one, and the ends are scraped very carefully to the surface plate. A finished set of twelve of these radial magnets represent a great many hours of careful work and a good deal of money.

H. L. A.

▲ ▲ ▲

The Action of the Shunt Motor.

BY WM. BAXTER, JR.

The general principles of this style of winding can be illustrated by the aid of Fig. 1. Those who have acquired their knowledge of electricity from the old text-books will be somewhat surprised at what we are about to say in connection with this diagram. In these books we are told that electricity always takes the shortest path; and that therefore, if it can get back to the point from whence it started by a short route, it will entirely ignore the long ones. This statement is not true. If two paths are provided for an electric current, and one is very short while the other is very long, it will divide and go through both paths. If a thousand or

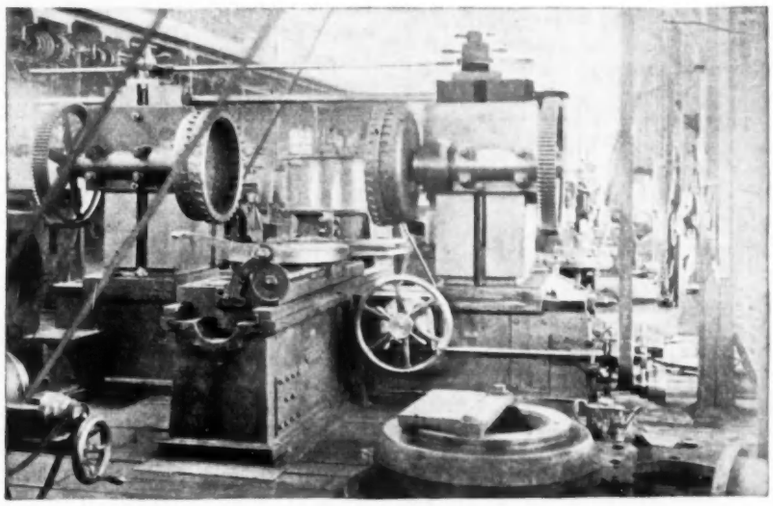


Fig 33. MAGNET-MILLING MACHINE.

many thousand paths are provided, it will pass through every one of them; but the amount of current that will pass through the various paths will be inversely proportional to their resistance.

If in Fig. 1 we assume a current to come along the large conductor C, as shown by the arrow, at the point P it will split, so to speak, and part will pass through the resistance R, while the bulk will continue along the large conductor. If C were a large copper bar, and R were composed of many miles of fine wire, the case would not be altered. In fact, if the two points $P\,P^1$ were very close together and R were long enough to go around the world, there would still be a current passing through R. If the difference of potential, or pressure, between the points $P\,P^1$ is maintained constant, the current through R will remain unchanged, no matter how much it may be increased or decreased in C. This fact is utilized in shunt-wound motors to obtain a constant field. Fig. 1, in fact, is a simple diagram illustrating the winding of such a motor, the portion of the conductor C between P and P^1 representing the armature. Regarding this figure as a diagram of the winding of a shunt motor, we can say that, if the difference of potential between P and P^1 is kept constant, the current through the field coils R will be constant, and the strength of field will remain unchanged.

A great many students of electricity find difficulty in understanding this statement. They can realize that a part of the current in C will pass through R, but they cannot understand why a reduction of current in C will not cause a corresponding reduction in the current passing through R. If P and P^1 were connected by a plain conductor, as shown in the figure, their reasoning would be perfectly correct, because, the resistance between P and P^1 through the large conductor being fixed, the current could only be made to vary by varying the difference of potential between P and P^1, and this difference of potential would affect the current in both P and R. As has been explained in these columns, the opposition to the current in the armature is made up of the true resistance of the armature wires and the counter electromotive force of the armature, which latter varies with the speed of the motor. Under these circumstances, if the current that operates the motor is maintained at a constant potential, the

difference in pressure between P and P^1 will remain constant. The current between P and P^1 through the armature will then vary with the speed, but the current through R will remain constant without regard to what may be taking place in the armature.

Fig. 2, which is a more elaborate diagram of a shunt-wound motor, will enable us to explain more clearly what follows. The current coming in from the source of supply, through P, splits at D; part con-

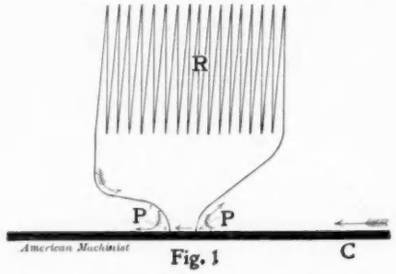


Fig. 1

DIAGRAM OF SHUNT-WINDING.

tinuing through P to the brush B, and through the commutator C and armature A to the brush B^1, and thus on to N. The other part of the current passes through P^1 to the terminal C of the field coil M, and from the end of this coil, through the wire E to coil M^1, from which it passes out at C^1 and joins N at D^1. Now, the difference of potential between the two wires P and N is maintained constant by the generator that supplies the current, without any regard to what takes place in the motor. This being the case, the strength of current through the field coils

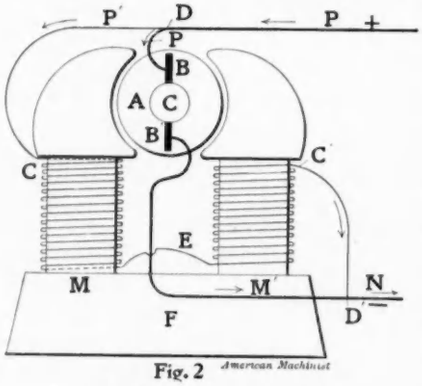


Fig. 2

SHUNT MOTOR OR DYNAMO.

will remain constant whether it changes through the armature or not.

The resistance opposed to the passage of the current through the armature is, as has been said, composed of two parts—the ohmic resistance of the wire and the counter electromotive force. The amount of power that the armature will develop will be proportioned to the product of the current by the difference of potential between P and N, less the electromotive force absorbed in overcoming the ohmic resistance of the armature. The amount of current that will pass through the armature will be equal to the difference of potential between P and N, less the counter electromotive force divided by the ohmic resistance. This being the case, it follows that the smaller the armature resistance, the greater the change in current for a given variation in counter electromotive force. If the armature resistance is made very small, a small change in counter electromotive force will cause a considerable change in current, as was explained at length in an article on "Electromotive Force, Counter Electromotive Force and Speed," which was published in the issue of May 14th. Now, as the field is kept constant, the action will be the same as with a machine having its fields excited from an independent source, and a small change in speed will be followed by a proportionate change in counter electromotive force.

In order to show just how much of a change would be required, we will take a practical example: Suppose we consider a 10 horse-power motor having an efficiency of 90 per cent. The 10 per cent. loss would be divided about as follows: Mechanical losses (friction, atmospheric resistance, etc.), 3 per cent.; currents generated in the armature core and pole pieces, hysteresis, etc., 4 per cent.; loss in field coils, 2 per cent.; loss in armature coils, 1 per cent.

In order to make the armature loss 1 per cent., it will be necessary to have the resistance of the wire so low that the electromotive force absorbed by it when the motor is working up to its full rated power will be 1 per cent. of the total electromotive force, or difference of potential of the current. If by reason of a decreased load, causing an increase of speed and counter electromotive force, the current is reduced one-half, the electromotive force absorbed by the armature wire resistance will be one-half of what it was before—that is, one-half of 1 per cent. of the applied E. M. F. In the same way, if the current is reduced to one-tenth, the armature wire resistance will absorb only one-tenth of 1 per cent. of the electromotive force. From this it will be seen that, if the armature resistance is made so low that the armature loss at full load is 1 per cent., then the variation in the counter electromotive force that the armature must develop between full and no load will be within 1 per cent. As the armature rotates in a field of constant strength, the counter electromotive force will be exactly proportional to the speed; therefore, the variation in speed of such a motor between full load and no load will be less than 1 per cent.

It may be asked—Can motors be made that will regulate as closely as this? To this we can answer, that not only can they be made, but that, as a matter of fact, nearly all motors of 10 horse-power or over, made by first-class concerns, will regulate as closely as this; that is, if the electromotive force of the operating current is kept constant. But this condition is never realized; and on this account such refinement of regulation is never obtained in practice, although, as will be seen, through no fault of the motor. Poor regulation in a shunt-wound motor is not obtainable except with very low efficiency. Although the principles upon which the close regulation of speed in shunt-wound motors depends, are very simple, as the foregoing explanation shows, they were not understood ten or twelve years ago except by a very few of the best electricians.

▲ ▲ ▲

Letters from Practical Men.

The Efficiency Craze.

Editor American Machinist:

Some years since an acquaintance of mine wrote to the late George H. Corliss, then at the height of his glory as a builder of steam engines, inquiring the price of a 100 horse-power steam engine, and of a boiler of sufficient capacity to supply it with steam; also what efficiency of the plant he would guarantee, or words to that effect. Considerable agitation was then in progress in relation to the performance of a steam plant—the performance actual and possible—as well as to the ways of determining and defining it, and the writer to Mr. Corliss wanted to avail himself of all that had been done in the matter—wanted to know the exact efficiency Mr. Corliss would agree to produce. He was not an ignorant man by any means; but he knew no more about what efficiency as applied to a steam engine or boiler meant than he knew about Choctaw verbs.

In due time a reply came from the Corliss Works, written by someone authorized to reply, to the effect that Mr. Corliss did not care to furnish engines or boilers on the basis of competing against something that no one knew anything about except engineers, and upon which no two of them could or would agree; that he would furnish him with such an engine and boiler as he required, and if the power developed did not exceed 100 horse-power he would agree, and so specify in the contract, that the coal consumption should not exceed —— pounds in twenty-four hours, this to include the coal required to keep the engine running ten hours, and to bank the fire. The kind of coal to be used was not named, it being taken for granted that the kind used in that vicinity was meant. Mr. Corliss, so his letter read, believed that what his customers wanted to know was how much their coal would cost them, with ordinary good management, and not the least amount the engine could be run on under conditions that could not obtain in everyday practice, with ordinary good attention.

I often think of this in reading of fine-spun tests (which are certainly not to be condemned for certain purposes) that no one but an educated engineer can under-

stand, and which he cannot understand the same as another engineer does.

The owner of the steam plant is certainly one of the most interested parties as to the cost of his motive power, and the simple and comprehensive manner in which the letter referred to covered just what he ought to know, viz., what will it cost me to run such an engine as I require, must have been—was—satisfactory. What interest would he have in the contemplation of terms and statements that were meaningless to him, and which to study up would be a sheer waste of time? If it comes to trouble, and the contract is shown in terms that are easily comprehended, and the processes by which results are reached are as easily understood, much trouble and expense may be saved. A competent engineer—his own, if he has such an engineer as he ought to have—can tell the purchaser if he has a fighting chance, which is just what he wants to know, and he can have the satisfaction of watching the progress of his case with some degree of interest, because he can understand what is going on; terms are used that are plain to ordinary mortals.

On another occasion I wrote similarly to the Corliss Works in reference to an engine of different size, and received an answer similar to that which my acquaintance received.

I believe such a statement of the case as in the Corliss letter is, so far as the cost of fuel is concerned, eminently right, and satisfactory to the ordinary purchaser of a boiler or a steam engine, whose interest is naturally centered upon cost of operation, and who objects to having his mind diverted from the direct issue by what to him is irrelevant.

FRANK GLEASON.

▲ ▲ ▲

Wood Alcohol Objectionable.

Editor American Machinist:

In the May 14th issue of the "American Machinist" is the question (No. 102) whether it would make any difference in the quality of shellac varnish for patterns if methylated spirits is used as a solvent in place of grain alcohol.

As your correspondent writes from Montreal, Can., it is not improbable that he refers to methylated spirits under the strict definition of the term, which is grain alcohol mixed with about one-ninth of its bulk of pyroxylic spirits or wood alcohol. This mixture is admitted free of duty in Great Britain and is used extensively in the arts. As the percentage of wood alcohol would not be great in this mixture, it could no doubt be used satisfactorily as a solvent for shellac varnish used on patterns.

As methylated spirits are not used extensively in this country, and as the term might be taken to mean wood alcohol, your answer, while practically correct, could be misleading. Wood alcohol upon evaporating leaves a resinous residue which, being left upon the surface of a pattern, becomes soft and gummy in the moisture in the mold, causing the pattern to stick and not draw well.

Wood alcohol is, of course, cheaper than grain alcohol, and for this reason is used for large patterns. I have found it very objectionable for small work.

WARD LINCOLN.

Rock Falls, Ill.

▲ ▲ ▲

Protecting Wooden Patterns.

Editor American Machinist:

Noticing inquiry (102) of P. J. D., of Montreal, for a varnish to prevent warping of patterns, would say that I recently made a number of patterns for large concave and convex laps for grinding lenses used in our search-lights, and found it impossible to keep them from warping long enough to get castings fit to be ground together. After having turned the patterns true several times without any success, I scraped off all the shellac, trued them up again, and applied a coat of P. & B. compound, made by the Standard Paint Co., of New York.

The patterns remained perfectly true, and I believe the warping was due as much to the shellac as to the damp sand. The P. & B. compound is, I believe, a mixture of asphalt and rubber dissolved in bi-sulphide of carbon. It dries very quickly and requires some skill to apply evenly.

S. M. RUSHMORE.

Jersey City, N. J.

▲ ▲ ▲

Solid Dies.

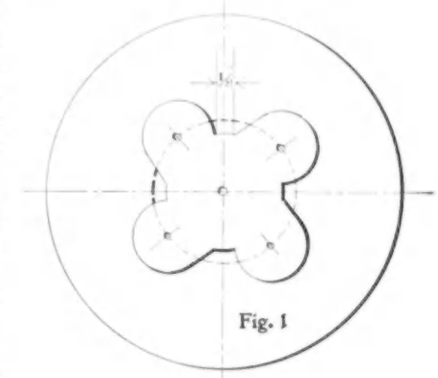
Editor American Machinist:

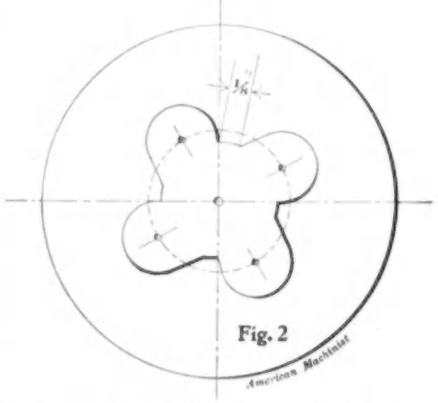
In No. 20 of May 14th, I notice directions by "Treb" how to make monitor lathe dies so that they will do satisfactory work for thirty days and not break. I have been waiting to see further discussion on this die construction by one of the well-known "American Machinist" writers. Having been disappointed in my expectations, I herewith ask for further light on this subject. I am quite interested in threading dies myself, though not in such of the "solid" construction.

It seems clear that the four cutting edges, located as they are, should be efficient. I also see the advantage of the depth of die—i. e., one and a quarter times diameter of bolt—providing the die is kept well flooded with oil, which it should be in all cases. It also seems proper to provide for enough space ahead of the cutting edges for a heavy chip to roll up properly and without jamming. To these three features alone, I think, must be ascribed the satisfactory working of "Treb's" die. Upon one point, however, I would like to be instructed, and that is—how Treb makes out that his cutting edges are $\frac{1}{16}$ inch ahead of the center.

Fig. 1--Here is the die as shown in No. 20, with cutting edges supposedly $\frac{1}{16}$ inch ahead of center, and in Fig. 2 the same die is reproduced with center lines drawn from the cutting edges of teeth. The center lines are "fair and square" in both Figs. 1 and 2. Does not the die Fig. 2, which now, by just shifting the die around a little ($\frac{1}{16}$ inch), cuts right on the center lines (*sic*), do exactly as good work as the one shown in Fig. 1?

In fact, it would not make any difference where you put the center lines in a circular cutting die. The die does not mind it at all; it will go on doing its work just the same. Were the threads actually "relieved" all the way, or even part of the way through, it would be a different thing; but in this case they are not relieved. Three threads are gradually cut away on the face of die, and do nearly all the work of threading.





CUTTING FACES OF SOLID DIES.

To my notion, the angle of cutting edge is too great in the two sketches. It must be, I judge, about 90 degrees. The angle of rear of cutting edges should do good work in polishing threads on bolt as the die is backed away, and if there are no small chips to be caught and jammed in between die and bolt. It appears almost as though, in this form of solid die, the angle of cutting edges had very much to do with the efficiency of die, aside from general strength and proper temper.

Try to set a thread chasing tool, with-

out clearance or without being relieved, into a tool post $\frac{1}{16}$ inch over center, and let *A—B* represent the center line, as in the two sketches—would it not act funnily?

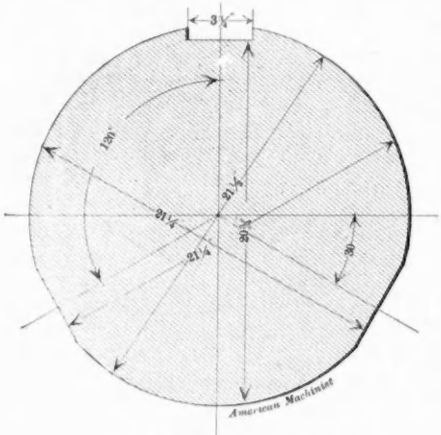
KIRSCH-KING.

▲ ▲ ▲

Keying the Armatures on Large Dynamos.

Editor American Machinist:

Having recently installed one of the large Siemens-Halske generators, I have been very much interested in your illustrated articles, describing the methods of construction, and can testify to the good work on this machine. Their method of holding the armature on the shaft is first-class; and while there is probably not



ONE SYSTEM OF KEYING.

much new, it is an arrangement with which one man can securely hold the armature or take it loose with ease.

The large fly-wheels are usually put on so that they can be neither tightened nor loosened, which makes the Siemens-Halske method of keying very acceptable. The shaft has one sunk keyway and two flats, 120-degree angles from the center, and each key has a properly designed head, so that tap bolts passed through the key-heads and into the armature provide means to pull the key in tight. The holes in the key-head are tapped; and by substituting the larger size bolt to fit the thread in key-head, the key can be readily withdrawn.

Inclosed is a cross-section of shaft, showing keyways.

T. ELLIOTT.

Atlanta, Ga.

▲ ▲ ▲

Glass Machinery Bearings.

Editor American Machinist:

I was much interested in the description of experiments on glass bearings for machinery by G. D. Rice, in your issue of May 14th, and believe that such bearings in one form or another will be found useful, especially for light, swift-running machinery.

It occurs to me that much better results than those given by Mr. Rice might be obtained, if the glass, instead of being merely cast, were annealed, very much as chemical beakers and test tubes, Pittsburgh lamp chimneys and other articles of glassware are annealed. In this way its toughness and resistance to shocks and heat might be greatly increased, and the lack of these properties is the chief objection to glass bearings.

The efficiency of such bearings depends, of course, on the frictional resistance of shafts running in them as compared with those running in babbitt and other metals. Can anyone tell what the real gain in this respect would be?

SPIRAL.

▲ ▲ ▲

How to Charge a Cupola.

Editor American Machinist:

I was glad to find Mr. Grindrod's letter in your issue of May 21st, about "Charging a Cupola," for there seems to be, as he says, very little data obtainable on this subject. Our best writers say that this matter must be left mainly to the judgment of the melter. But when a new man is suddenly called to take charge of a cupola in an emergency, as was the experience of the writer lately, he needs something besides the judgment of a man who isn't there. Mr. Grindrod's figures came in just the right time for me, and were very refreshing in comparison with the uncertainties which I had been reading. But when I tried to apply his rule to our cupola, I found first a serious error in his mathematics, and, correcting this, I found that if I put a bed of our coke (which is supposed to be good Connellsville) in our cupola, by his rule, it would bring the top of the bed 5 feet above the top of tuyeres, whereas the only other authorities which I have unite in saying that, for coke, the top of bed should be 1½ to 2 feet above top of tuyeres. Now, here is too much difference, and I am "at sea" again. Will some one ratify Mr. Grindrod's rule, or give a better one?

It has occurred to me that our coke may be too light, and I have weighed a large boxful and find that it weights 23 pounds to the cubic foot. Is this right?

The error in mathematics to which I referred is in the proportion. The capacities of cupolas do not increase directly as their diameters, but about as the squares of their diameters. Therefore, Mr. Grindrod's figures should read thus: Taking a 30-inch cupola and 571 pounds of coke as units, to charge a 42-inch cupola, $30^2 : 42^2 : : 571 : x = 900 : 1{,}764 : : 571 : x = (571 \times 1{,}764 \div 900) = 1{,}119$ pounds of coke for a 42-inch cupola bed, etc.

J. C. GREEN.

Hackettstown, N. J.

▲ ▲ ▲

Doings at Backaway—Smeaton's Plan for Reducing Costs.

Editor American Machinist:

Two or three years ago I wrote you about Smeaton's plan for reducing costs. Other mill superintendents laughed at Smeaton's plan; but Smeaton's plan was Smeaton's success. They all reasoned that when expenses must be reduced, the first thing to do is to cut down the wages. Now, Smeaton's idea was that when you paid good wages and treated your men well, you had a right to expect good work and attention to your interests from them.

Smeaton was right. What the other mills had done was just to post notices that from such a date there would be a reduction of ten per cent. in the wages paid. What right had the workmen to be heard in the matter?

Now, it had gone forth from the directors of the G. & I. that the cost of production must be lessened, and Smeaton was one of those directors. Smeaton was just dead set on seeing a man go home Saturday night with a good, comfortable envelope; but he wanted him to leave behind him, in the mill, the equivalent of the good money. Wasn't running any Aid Society for Incompetents. It always seemed to me as if he had the most settled antipathy to reducing wages of any man I ever saw.

Smeaton had simply made up his mind that his machinery should have something to do with cheapening production. The work of the machinist, Smeaton reasoned, when properly directed, resulted in increasing the output of the mill, and that was just what was needed, and just what was given too little attention.

The next day after the directors' meeting, at which, on Smeaton's motion, it was voted to reduce the cost of production, Smeaton asked me to go up into the mill with him, and ran me right up against one of the most important machines in the works—750 of them working.

"Oldone," he says, "I see you have got the new spring and catch-up arrangement on every one of these machines, and I want to congratulate every machinist in these works on the manner in which the work has been done. That drop and catch-up occurs sixty times a minute, but in the way the new arrangement works there is an appreciable interval of rest. Now, tell me why that drop and pick-up cannot just as well occur eighty times a minute as sixty. Don't care anything about the parts wearing out. You say they are all made to templet, and you can have all the machine shop and all the machinists you want to keep the parts likely to wear out—duplicates—right in hand. You say it doesn't cost much to make them, and just about no time to put them in place. When you can see that another machinist will help in this, then put on another machinist. What does their wages amount to in comparison with the product of two thousand men in the mill, when every one of these men goes out Saturday night and leaves behind him a little more product?"

Wasn't any signs or notices posted in the mill. Smeaton asked the workmen

to meet him in the hall one evening, and stated the whole case to them. He put it just as it was, and got cheers for his action. It looked as if there couldn't possibly be any trouble in the matter.

Well, there wasn't any trouble of any account, and what there was, was made by one of the most intelligent machinists in the shop. When Smeaton invented his knot-and tie machine, I just had the patterns made and then put the whole matter right into Grumler's hands. We didn't, of course, have the tools for the work; but that didn't seem to trouble Grumler. He had a hammer and chisels and files, and he was a mechanic. The machine came together all right, and there wasn't a man that, so well as Grumler, could tell just what tools would be required to make a specialty of manufacturing Smeaton's machine. But Grumler made all the trouble that was made about Smeaton's plan.

You see, the way the G. & I. is run, there isn't any room for cheap machinists. I'm not sure that there is room for them anywhere, probably because I never found any room for them. You have to have men at the G. & I. that can do the best job that runs up against the machine shop, or that will get away, without grumbling, with just the cheapest kind of a job.

It came about that in carrying out Smeaton's plan about 500 small pulleys were required. We made the patterns and determined to make the pulleys ourselves. As things turned, it seemed best that Grumler should be set chucking these pulleys. Now, Grumler didn't care for this. Understood that at the G. & I. a man would be bucked up against a job that would puzzle him one day, and the next day get at a job in the doing of which he could rest all his energies.

Grumler didn't mind chucking the pulleys, but he didn't like Smeaton's plan, and here was his opportunity. The machinists were working on their honor. Nothing had been said to them; they all knew Smeaton's plan, and there didn't seem to be any use in talking, particularly, to twenty men who were in the habit of reasoning right up from cause to effect, as twenty good machinists would be.

Well, you ought to have seen the speed Grumler put that chucking lathe to. Spent the greater part of his time in grumbling to the other men about Smeaton's plan. Couldn't tell where it was wrong, but it seemed as if he couldn't stand being put on his honor. Some men can't. He really thought that he was doing the mechanical world a great favor in doing all he could do to oppose Smeaton's plan. He was a bachelor, and would break up his last dollar and spend the last cent of it to assist the poorest helper in the works, and he'd do it just as if he were looking for a chance to do something of the sort.

He was one of the kind of men you like to have around a shop; but something must be done. Even Smeaton had noticed the way Grumler was carrying things along, and just quietly told me one day that he needed soothing some way. I'd rather been chased four times around the block than tackle the job, but it had to be got at. I sent for Grumler. I stated Smeaton's situation just as it seemed to me. Had to be loyal to the company, company paid him a good salary for that; wanted to do the best he could for every man in the mill, and he didn't get a cent for that. I talked to Grumler about Smeaton's plan just as one mechanic would talk to another, and that's what generally counts when you talk to a mechanic.

I sometimes think that there wouldn't be much trouble in this country between honest mechanics and honest proprietors or superintendents, if they were in the way of talking just exactly straight. I always think there wouldn't be much trouble if this was a sort of universal law. There never was a downright good mechanic who didn't like to see a downright good employer make good money off his work. I wouldn't give four cents for a mechanic who didn't think, or who couldn't be brought to think this way; want to make good wages himself, and want his employer to make good money.

Grumler listened attentively to my rather disconnected talk, and when I was talked out he got up and walked across the floor two or three times. Then he stopped and said: "Mr. Oldone, I'm not the first fool you have met. I've been a fool in this matter. I've always been used like a white man here, and I've bucked right up against being used in that way. If I could give advice, it would be to give me my time. I think that's what I'd do under the circumstances."

I told him that was just what I didn't propose to do. Going to put every lathe that could be spared turning those little pulleys, and when he had them all chucked, I had proposed that he should begin arranging them on the machines. Wanted him just to understand the situation, and work right along as usual.

"Mr. Oldone," said he, "I see the whole matter as I have never seen it before. I can lay those chucked pulleys on the floor, five to one of what I have been doing, and it will not be any harder work. Sort of relief to see them slip right in the chuck and slip right out."

Grumler went back to his work. There hadn't been an unpleasant word spoken; but there was just about one pulley in the air all the time.

Smeaton's plan has proved a success. There isn't a man around the works that gets one cent less now than before Smeaton's reduction. In the speeding-up some get a little more, but not one less. No man is overworked, and everyone seems pleased.

I am not trying to set Smeaton up as a humanitarian, or anything of the sort. He is running the G. & I. right in the interests of the stockholders of the G. & I. Part of his plan is to keep the workmen satisfied. The company makes money through Smeaton's plan, and I have no doubt that Smeaton gets satisfaction in more than one way.

JOEL OLDONE.

▲ ▲ ▲

American Textile Machinery in Belgium.

Charles J. Murphy, Commissioner at Brussels for the State of Iowa, sends us a copy of the following letter, received by him from a prominent merchant of that city:

"Brussels, May 10, 1896.

"Charles J. Murphy, Esq.,
"Commissioner for the State of Iowa:

"Dear Sir—I have much pleasure to tell you that the last time that I was at Verviers, I had the occasion to visit the work rooms of the recently opened Société Anonyme des Filateurs de l'Ile Adam.

"I was very much astonished to meet with some of your country's productions there. This spinnery possesses, indeed, a good many of spinning engines of American make; that is to say, imported from America.

"The manager of the establishment told me that these engines, which are very cleanly finished and carefully constructed, give the greatest satisfaction, and are a good deal superior to the English ones.

"As I know that you take a great deal of interest in all American productions, I thought that it would be agreeable to you by communicating this fact to your attention.

"Faithfully yours,
(Signed) "H. HEIDEREICH."

▲ ▲ ▲

Abuse From Oil Swindlers.

The Cleveland oil swindlers are being informed by some of our friends that their offers of half-barrels of oil at special prices are being sent to us, and this seems to make them very angry.

One of these "companies" sent its proposition to the Straight Line Engine Co., and at the same time another oil company sent a similar proposition to the Direct Separator Co., not knowing, of course, that the two propositions would reach the hands of the same person, i. e., Professor Sweet. Upon being informed that the matter had been referred to us, an abusive letter was written and signed "Beech Oil Co.," the name of no individual or officer appearing in the letter. We also have received abusive letters from some of these "companies," but, of course, do not feel greatly cast down on that account.

American Machinist.

Published every Thursday
by the
American Machinist Publishing Co.,
256 Broadway, New York.

Angus Sinclair, Pres't. John A. Hill, Treas.
C. A. Hansmann, Sec'y.
C. P. Day, Manager Adv. Dept.
Fred J. Miller, Editor.
Frank Richards, F. A. Halsey, Edward P. Buffet, } Associate Editors.
A. L. Donnell, Dept. of Illustration.

▲ ▲ ▲

Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

▲ ▲ ▲

SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1895.

▲ ▲ ▲

The Bicycle Business.

Altogether, it seems likely that the bicycle business will follow the course of the sewing-machine industry, and will continue to be large and fairly profitable, but only to the larger and better equipped factories with the best reputation for quality of work. Something of a "slump" has long been expected in bicycle circles, and those who should be best informed are quite generally agreed that some decidedly interesting features will develop before this season's trade is closed.

Extravagant notions regarding the profits of the business have been prevalent; and many ill-informed persons have concluded that, because large and well-equipped factories made large profits, almost anyone could go into the business and make money. Cases are rather numerous in which a man who could command ten or fifteen thousand dollars, but either totally without experience in manufacturing, or with the conceit arising from successful manufacturing in an entirely different line, has secured the services of a locally famed mechanic, equally innocent of all knowledge of real manufacturing operations, and started in to trade money for experience. In other cases the capital is furnished by locally formed joint stock companies, and it is frequently expected that the profits of the first year's operations will pay for the plant.

It is soon found that the manufacture of bicycles means something entirely different from building or repairing engines, that entirely different and strange tools are required, and entirely different men must be had to design and construct them; that the business is by no means so simple as it looks, and that before any profit can be made there must be an outlay of money that seems prodigious, and in fact is much greater than would be required if the business were undertaken by men more conversant with the actual requirements of the case. The refusal of these capitalists to put in more money is making the situation a difficult one for the managers of many establishments, and seems likely to bring about a considerable number of assignments and receiverships in the near future. Competition among the different builders is being felt more than at any previous time; and it seems quite certain that the ironclad agreement made by about ten of the leading manufacturers last winter, under the wing of the Cycle Board of Trade, is about all that maintains the price at $100. In fact, there are some wheels made to be sold under the terms of that agreement, that are now stored with little or no expectation of selling them at full price in the face of the present competition. At the close of the present season's business, when the agreement referred to permits, these wheels will be sold for much less; and in the meantime the familiar evasion of allowing liberal prices for practically worthless second-hand wheels, as part payment for new ones, is being resorted to very generally.

The next thing to look forward to, in our opinion, is the self-propelling or automobile carriage; and it seems likely that within a few years factories will be as busy making these as they now are making bicycles, and the wise man will apply to the coming business the lessons to be learned from the present one.

▲ ▲ ▲

An Arraignment of the Line Clique in the Navy.

A bomb-shell has been exploded in the camp of the clique of line officers that control naval affairs, by the publication in pamphlet form of a letter written by Asa M. Mattice, of Cambridge, Mass., late of the Engineer Corps, United States Navy, to Representative F. H. Wilson, the author of the House bill for improving naval matters, to which we have previously referred. Seldom has such a severe arraignment of any body of men appeared in print, and it is the more severe because couched in moderate language and written with an evident intention of being careful to say nothing not fully borne out by the facts of record.

The assertion is made that the Secretary of the Navy is next to powerless in the management of naval affairs, because the "machine" so manages matters that all communications with the Secretary, incoming and outgoing, are, with little exception, passed through the meshes of its net, and the information and advice, for which the Secretary must depend upon naval officers, is given mainly by members of the "machine." Numerous instances of gross abuses, growing out of this state of affairs, are given.

In this letter it is virtually charged that the trouble over the "Dolphin," which led to the death of John Roach, grew out of an attempt by the "machine" to discredit the Engineer Corps, and that the then Secretary of the Navy was grossly deceived, and Roach ruined, were simply as disregarded incidents of the struggle to secure legislation favorable to the clique.

It is charged that this clique put forth strong efforts to secure the establishment here of branch shipbuilding concerns by English establishments, and they actually persuaded our Secretary to import an English engineer to be chief designer of machinery at the Bureau of Steam Engineering; and a contract was actually agreed upon, but not carried out, because a faithful officer of the Marine Corps pointed out its illegal character.

Numerous instances of gross neglect of duty by line officers are given, by which, in many cases, valuable vessels were lost or injured; and the penalties inflicted for these offences are contrasted with the penalties inflicted upon staff officers for similar or less offences, in such a way as to show clearly, even if there were no other proof, that courts martial are under the thumb of the clique, and that in their decisions justice is disregarded in an outrageous manner.

It is quite certain that if every citizen of the United States could read this pamphlet, the abuses that have grown out of "machine" rule in the Navy would soon be corrected, even though a revolution in naval matters might be required to do it, and it is to be hoped that members of Congress will at least read it carefully. It shows very clearly just why so many of the best members of the Engineer Corps have left the service, and why every member of it, with sufficient ability to enable him to earn his living outside of it, or to be of any use within the corps, will leave it within the next few years, unless a remedy for the present outrageous condition of affairs is found and applied.

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(119) F. C. M., Utica, N. Y., writes: We do a great deal of hardening in oil, and in a short time the oil becomes too thick to use. Will you tell us the best way to thin the oil so that we will not have to throw it out? A.—We cannot suggest a way of thinning the oil that will not change it in other respects so that it will be unfit for service. There may be a good

hint in our article, June 4th, on the manufacture of twist drills, which speaks of the use of melted tallow for tempering purposes.

(120) J. F. V., Covington, Ga., asks how to temper "chicken gaffs"; wants a good spring temper, and they must not break. A.—Although a sketch of the article accompanied the question, we thought it best to look it up in the "Century Dictionary," and we find that the "gaff" referred to is a metal spur bound to the shanks of fighting cocks. We, of course, recognize the necessity of a trusty weapon in warfare, but have not had sufficient experience in this precise line to know the temper best suited to the purpose. Most blacksmiths know, or should know, the common method of spring tempering. The article should be carefully heated to a bright red and cooled in oil. When thoroughly cooled it is kept wet with the oil, and held in the fire and slowly heated until the oil blazes, the blazing of the oil indicating the heat to which the piece has been raised. When the heat of the piece is sufficient to blaze the oil, it is laid down and allowed to cool. Only animal oil should be used for this operation.

(121) R. H. S., Blue Springs, Neb., asks: 1. Will you publish a cut showing a common engine lathe boring out an engine cylinder, with full description? A.—We are not in a position to publish the cut asked for, and we do not think it would be a proper thing for us to do if we could. Boring a cylinder on an engine lathe would in these days be a make-shift job, the mode of doing which would be determined by the style of lathe available, and the dimensions and peculiarities of the individual cylinder to be bored. A description for one combination of lathe and cylinder would be of little help for some different combination. Make-shift jobs are always being encountered in every jobbing shop, and in isolated shops everywhere, and much ingenuity is often successfully employed in such work; and it is this ingenuity, in combination with wide and varied experience, that must be relied upon for such work. 2. Please tell me how to lay out a gear; or, in other words, how to make a drawing of a gear of a certain pitch. A.—As a large portion of every book published upon mechanical drawing is devoted to the drawing of gears, it would be proper to consult one of those books. It would not be proper for us, or fair treatment for our general readers, to spare the space necessary for a thorough explanation.

(122) "Constant Reader," New Orleans, La., asks: 1. What will be the I. H. P. of a pair of marine engines of the following dimensions: High-pressure cylinder, 20 inches diameter; low-pressure cylinder, 32 inches diameter; cut-off, 13 inches of high-pressure cylinder; stroke, 2 feet; revolutions, 105; boiler pressure 125 pounds? The engines are for a tugboat and have a surface condenser. A.—By a "pair" of engines we understand one compound engine, or one cylinder of each size. It has been customary, in computing the horse-power of a compound or a multiple-expansion engine, to assume that all the work of the engine is done in the last cylinder. It is perhaps simpler to assume that the work is done in the first cylinder instead of the last, and there is no apparent reason why an equally close approximation might not be attained. The working length of the high-pressure cylinder being 24 inches, the equivalent length of the low-pressure cylinder will be $20^2 : 32^2 :: 24 : 61.44$ inches, and the work may then be assumed done in a cylinder 20 inches diameter, and $24 + 61.44 = 85.44$ inches long. The cut off being at 13 inches, the ratio of expansion will be 6.57, or, inversely, .152. The ratio of the absolute mean effective pressure to the absolute initial pressure, for this rate of expansion, is .422. This is derived from the formula, $17 \times \frac{1}{R} - 16 \times \frac{1}{(R)}\,\frac{17}{16}$, $\frac{1}{R}$ being the reciprocal .152 of the expansion ratio. We may assume that the initial pressure in the cylinder is somewhat lower than the boiler pressure, or, say, $120 + 15 = 135$ pounds absolute, and the mean effective pressure will then be $135 \times .422 = 56.97$ pounds. From this we deduct, say, 5 pounds for back pressure, making the mean effective, say, 52 pounds. The length of the cylinder, it will be remembered, we made out to be 85.44 inches, or 7.12 feet; and as double this, or 14.24 feet, would be traversed per stroke, the I. H. P. will be $20^2 \times .7854 \times 52 \times 14.24 \times 105 \div 33{,}000 = 740.18$. 2. The tug is to receive a new boiler, 15 feet long by 8 feet 6 inches diameter, Scotch type, with 102 3½-inch tubes 11 feet long, and two flues 33 inches diameter; total heating surface, 1,255 square feet; grate surface, 36 square feet. Is that sufficient? A.—The volume of steam used will be $20^2 \times .7854 \times 26 \times 105 \times 60 \div 1{,}728 = 29{,}779$ cubic feet per hour. From a steam table we find that 1 cubic foot of steam at 120 pounds weighs .3042 pound; we then have $29{,}779 \times .3042 = 9{,}058.77$ pounds. To this at least one-third should be added, which gives us $9{,}058.77 + 3{,}019.59 = 12{,}078$ pounds of water. As there are 36 square feet of grate surface, the water required to be evaporated per square foot will be $12{,}078 \div 36 = 335$ pounds per hour. This we regard as decidedly too high, and the boiler we should consider too small for satisfactory service.

▲ ▲ ▲

Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Adding Machine. Grant: see page 26.

Forming Lathes, Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Honest Mach. Oils. F. S. Pease Oil Co., Buffalo, N. Y.

Bevel gears with planed teeth. Boston Gear Wks.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Practical Guide for Firemen, by Wakeman; 80 pp.; 75c., post free; Am. Indus. Pub. Co., B'port, Ct.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

Form'g and reliev'g lathes for back'g off formed cutters; gear cutters for cutting 2 teeth at a time, any pitch, 2 to 48. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

For Sale or Rent—Foundry and Machine Shop with additional land; in good condition and well equipped for medium heavy work. Capacity of foundry, seven tons per day. Located on railroad within eight miles of New York. Terms easy. Call or address, Room 41, 22 William st., N. Y.

Death of Augustus S. Chase.

Augustus Sabin Chase, a prominent manufacturer of Waterbury, Conn., died recently in Paris, where he had gone on a pleasure trip. He was not a mechanic, but started in life as a clerk, and his attainments were in commercial lines.

At the time of his death he was President of the following companies: Waterbury National Bank, Waterbury Manufacturing Company, Waterbury Watch Company, Benedict & Burnham Manufacturing Company, Waterbury Buckle Company, Smith & Griggs Manufacturing Company, the Waterbury American and Waterbury Printing Company. Among other concerns with which he was identified, either as director or stockholder, were the American Pin Company, American Mills Company, Waterbury Brass Company, Scovill Manufacturing Company and Waterbury Clock Company. He was a member of the Board of Agents of the Bronson Library, Waterbury, First Treasurer of the City of Waterbury, and at his death he was Treasurer of the Waterbury Sinking Fund, a position he held for twenty years.

▲ ▲ ▲

The New York City Civil Service Board will hold an examination for Leveler on June 25, 1896, at 10 A. M. Citizens of the United States, over eighteen years of age, are eligible to this examination. The salary ranges from $900 to $1,500. The examination will consist of Writing, Arithmetic, Technical Knowledge and Experience. Applications may be obtained by addressing S. William Briscoe, Secretary, New Criminal Court House, New York City.

▲ ▲ ▲

Prof. Howard P. Fairfield, of the Mechanical Engineering Department of the Case School of Applied Science, Cleveland, O., sends us a schedule of the Summer Courses in that institution, which extend from July 6th to August 14th, and include instruction in Chemistry, Mathematics, Mechanical Drawing, Pattern Making and Iron Work.

▲ ▲ ▲

Recent Inventions in Metal-Working Machines and Tools.

Figs. 1, 2, 3 and 4 show elevation, plan, and right and left-hand side elevations of the work table in a twist-drill milling machine, the invention of Mr. O. Parpart, of Cleveland, O.

The machine is designed to automatically mill a drill blank on one side with a groove of decreasing depth, drop the blank, revolve it 180 degrees, cut the second groove like the first, and then disconnect the feed mechanism.

As seen at A^1 (Fig. 1), the work table may be swung to suit work of varying pitch. The cutter is driven direct, and the blank fed by a splined worm wheel *H*, which rotates the form *K*. *H* is driven by a worm *M*, through the telescoping

shaft D. Reversing clutches at c and c^2 are actuated by s^1 S, from the rod Q, parallel to the work spindle. The mechanism

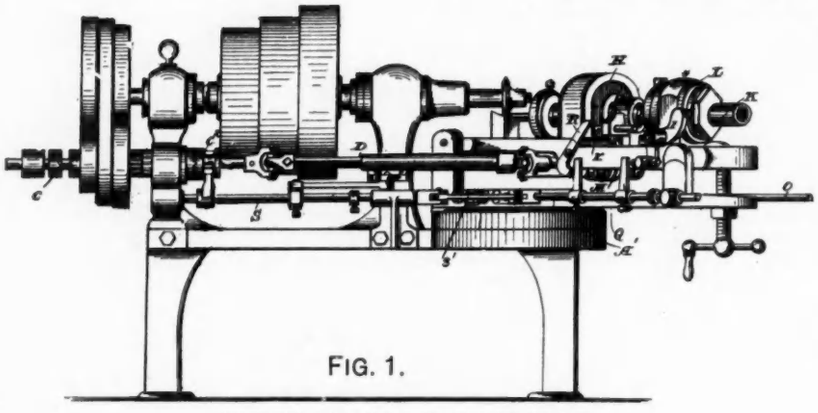


FIG. 1.

MILLING GROOVES IN TWIST DRILL.

at T T^1 gives a quick throw to the reversing clutches.

At O^1 (Fig. 3) is an eccentric shaft within an eccentric sleeve, which together carry the forward end of the work table. As the drill blank advances, rod O, driven by arm f, gradually lowers the front end of the table to decrease the depth of the groove. As the groove is completed, rod r (Fig. 4), through lever R, shifts rod Q, which first turns the eccentric sleeve surrounding O^1, to drop the blank clear from the cutter, and then, as described above, actuates the reversing clutches.

As the form K reaches its rearmost position, adjustable collar k strikes the revoluble sleeve L, and binding against it, detaches catch l^1, whereupon L is rotated 180 degrees. During this rotation, lug l^3 (Fig. 3) strikes arm l^4 (Fig. 4), thus throwing Q forward to raise the blank and again reverse the feed.

Arm f, above mentioned, reciprocates also n^6 (Fig. 3), and by pawl arm n^5 rotates N^1. Two throws of the pawl arm suffice to bring a bevel toe (not seen) into contact with the pin on the upper end of

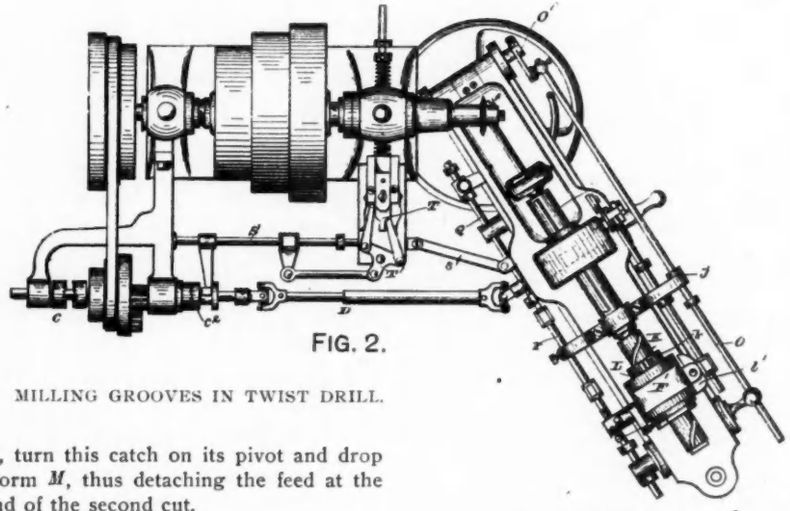


FIG. 2.

MILLING GROOVES IN TWIST DRILL.

N, turn this catch on its pivot and drop worm M, thus detaching the feed at the end of the second cut.

Figs. 5 and 6 show in elevation and plan a triple bolt or pipe-threading machine, the invention of Mr. H. P. Eilers, of Cleveland, O.

One head is driven from the cone by pinion E, the others being driven in like manner by pinions D^1 on studs in the frame. As the dies draw forward the work and carriages K, rods I^5 flex-toggle I just past the center, when they, and the dies, are quickly opened by springs N (Fig. 6). Yokes H, which shift the die sleeve, are pivoted on the adjustable nuts H^2 above the die-head. The size of the thread may be thus regulated, and wear in the die-heads taken up.

▲ ▲ ▲

Lots of "lathe work" is now done in the turret head machine and finished in the grinder and never sees a lathe. It is both better and cheaper.

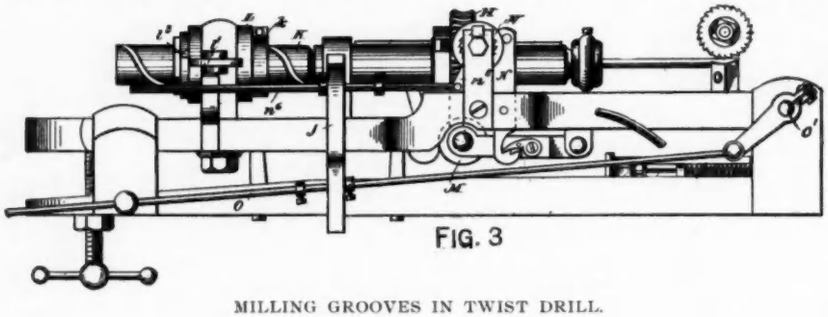


FIG. 3

MILLING GROOVES IN TWIST DRILL.

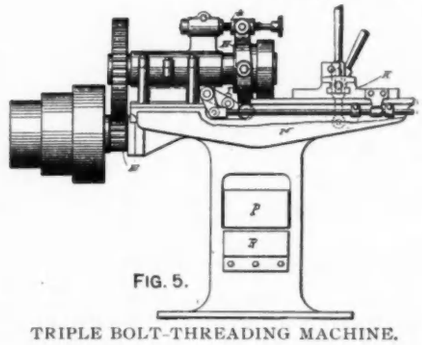


FIG. 5.

TRIPLE BOLT-THREADING MACHINE.

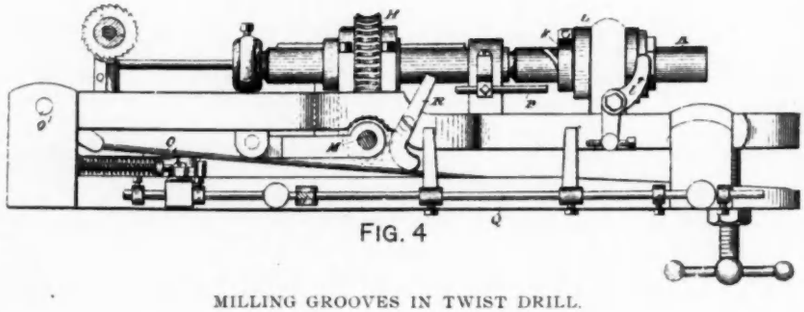


FIG. 4

MILLING GROOVES IN TWIST DRILL.

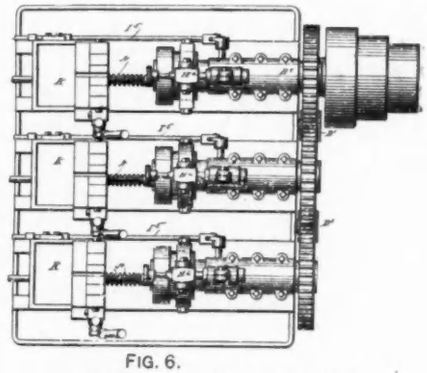


FIG. 6.

SCREW-CUTTING MACHINE.

Molding Bronze Tuyeres.

BY GEORGE O. VAIR.

As bronze tuyeres are not, comparatively speaking, common castings, it may be well to state that they are required in blast furnaces, and are used on the extreme end of the blast pipe which enters the furnace. In pig-iron-producing regions, the number of bronze tuyeres made annually runs into the hundreds. They are made in sizes varying in weight from 10 pounds to 150 pounds. The same method is employed in molding all the different sizes.

In these columns, recently, I tried to demonstrate the adaptability of using a hanging core in molding cone pulleys; and the object of the present article is to illustrate how an awkward job may be simplified by the use of the above-mentioned core.

Fig. 1 represents a sectional view of a mold and flask as it would appear all ready to receive the metal. The pattern being what might be termed a plain block of wood, it is not necessary to describe in detail the molding process, further than to say that the gate *A*, in Fig. 1, is cut previous to rolling the flask over, and covered with a piece of "slab," core *B*. There is no cope used; consequently, a bar is put across the top of cores *F* and *D*, and clamped at flask flanges *X X* to secure the cores. A circular hole is cast in this bar, to admit the anchor stem *C* of green sand core *D*. Core *D* is made in a core box, made in halves, which are clamped together while the core is rammed up, and the core is lifted out without unclamping it; there being no danger, as the anchor plate *E* is made nearly the exact diameter of the small end of the core.

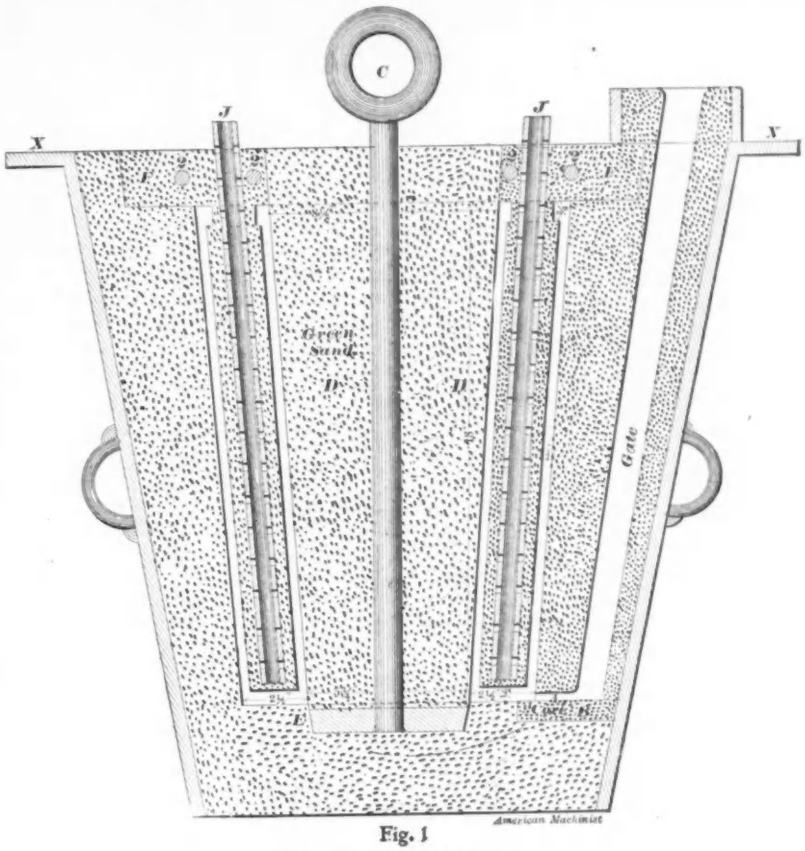


Fig. 1

THE MOLD COMPLETE.

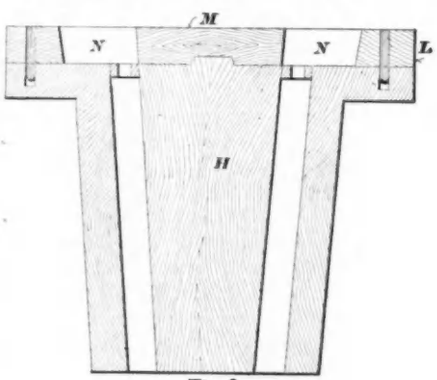


Fig. 3

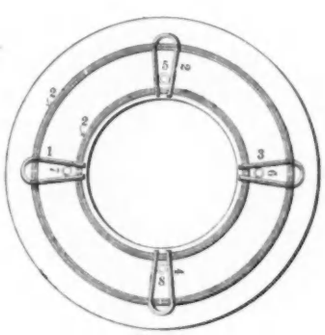


Fig. 4

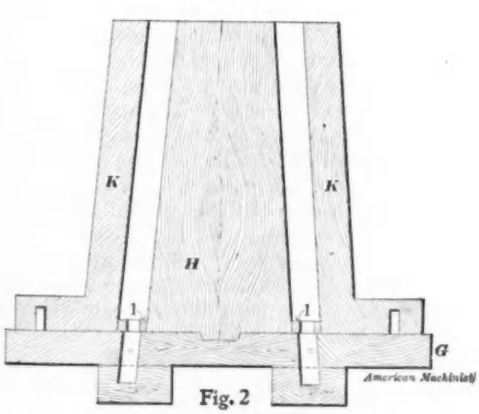


Fig. 2

MAKING THE CORES.

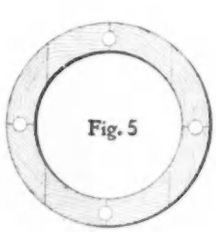


Fig. 5

The manner of making the main core *F* will be readily understood by referring to Figs. 2 and 3. The board *G* has a recess for center piece *H* and holes *O O*, of suitable diameter for gas pipes *J J* (of which there are four). On the board set the parts *H* and *K;* also segments 1, 1, which form the top thickness of casting. After which, drop in the perforated pipes *J J*. The ramming up of the core can then be proceeded with.

After having rolled the box over, the board *G* is lifted away, and parts *L* and *M*, Fig. 3, are put on. Having rammed vacancy at *N* about half way, the two circular core rods 2, 2 are put in; over the rods are then drawn the four pieces 1, 2, 3 and 4, Fig. 4, of bent round iron, ½ inch iron usually, of irregular shape. The only requisite is, that they are bent enough so that they will draw tight on pipes 5, 6, 7 and 8. To remove the core from box, withdraw center pieces *M* and *H;* put a little green sand on top of core, to raise core plate clear of bent pipes *J J;* then roll the core box over and lift it off.

With the exception of a single strand of tie wire around the bent pipes, about the middle of the core, the core rods shown in plan at Fig. 4 are all that are used in making those cores, which we think would be a revelation to quite a number of core makers, a great many of

whom use more rods than they do brains when at work.

Fig. 5 is a plan of the segments seen at 1 and 1 in Fig. 2. They are withdraws from the core after it has been dried in the oven.

A casting of such shape and thickness as represented in Fig. 1 would be difficult to make successfully if it was undertaken to set the core *F* on chaplets, and seam the vents through the cope. It might appear to some very easy, but it entails the cheeking-off of the flask to set the chaplets as near right as they would have to be on a casting ¼ inch in thickness, for a very small fraction in size of chaplets would shut off the thickness of metal at the top of mold. In fact, supporting the core on chaplets was formerly practiced, with the result that a molder made only two for a day's work. By using the core here described, the same molder is able to mold four times as many, and bad castings are practically done away with. These castings have to be perfect, as they are subject to water pressure and are all tested before being placed in the furnace. Water is run constantly through them when in use.

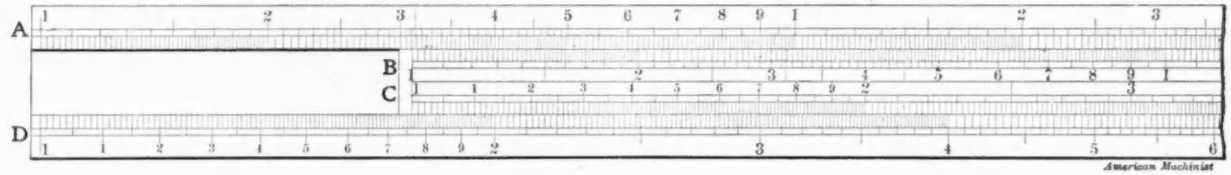


Fig. 5.

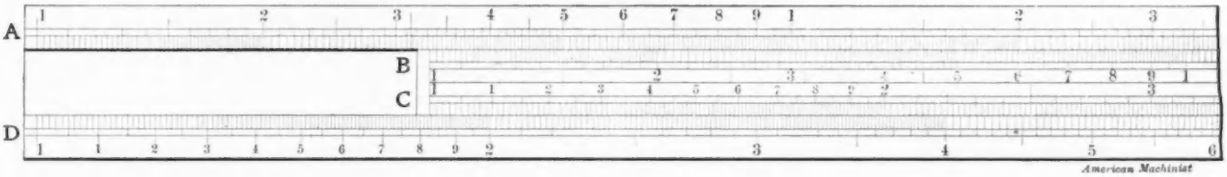


Fig. 6.

▲ ▲ ▲

The Use of the Slide Rule.

BY F. A. HALSEY.

Part III.—Finding the Decimal Point.

The next step to be taken is the method of finding the decimal point. In the case of small numbers, this will be done without reference to rules; but for large numbers, and for the multiplication of several factors, a rule is necessary:

Multiply 3,111 by 311 in the usual way, as follows:

```
  3111
   311
  3111
 3111
9333
967,521   Ans.
```

Again, multiply 3,333 by 333, as follows:

```
  3333
   333
  9999
 9999
9999
1,109,889   Ans.
```

In the first case, the first factor has four figures, and the second, three; while the product has six, or one less than the sum of the two. In the second case, the factors have the same number of figures; but the product has seven—that is, the exact sum of the two. All multiplications fall under one or the other case. That is, the number of figures in the product is the sum of those in the factors, or it is that sum less one; and which case a given problem belongs to is determined in the following manner: In setting the rule for multiplication, as has been described, if but a single half of scale *A* is used in the problem, then the number of figures in the product is the sum of those in the factors less one; but if both halves of scale *A* are used, the number of figures in the product is the full sum of those in the factors. Thus, taking the first of the two problems above, multiply 311 by 3,111 by the rule, as in Fig. 5. Setting 1 of *B* below 311, we find the figures of the answer to be 965 as near as we can read them, and in this problem the answer is found to the left of the middle division—that is, the problem has been worked entirely upon one-half of scale *A*. The number of figures in the answer is, therefore, the sum of those in the product less one—that is, $4 + 3 - 1$, or 6—and the answer is 965,000. Take, now, the second problem and multiply 333 by 3,333, as in Fig. 6. Setting 1 of *B* below 333 of *A*, we find the figures of the answer to be 111 as nearly as they can be read. The answer is now found to the right of the middle division of scale *A*—that is, we began the problem on the left-hand half of *A*, but find the answer on the right-hand half. Both halves have therefore been used, and the number of figures in the product is the full sum of those in the factors—that is, $4 + 3 = 7$, and the answer is 1,110,000. The reason for this rule will be plain on reflection that, passing over the middle mark from the left-hand half of the scale to the right-hand half, represents the change from the left-hand 9 of our first numerical problem to 10, which change is accompanied with an increase of one in the number of figures in the product.

It is no part of these papers to represent the slide rule as better than it is, and the above answers will be seen to be not strictly correct, because the slide rule cannot give them correctly. The errors, however, will be seen to be less than the limit named in the first paper. In the first case the error is 2,521 parts in 967,521, or one part in 380; and in the second case, 111 parts in 1,109,889, or one part in 1,000. The errors look large because the numbers are large; but as percentages, they will be seen to be insignificant for most purposes.

In the case of multiplication of numbers having decimals attached, the number of figures in the whole number parts only are to be counted in pointing off. This is the reverse of the usual method of multiplication, in which the number of figures in the decimal parts of the factors are counted, and the answer is pointed off by counting from the right. With the slide rule, the number of figures in the whole number parts of the factors are counted, and the answer is pointed off from the left. Thus, in the last problem were the factors 3.33 and 333.3: The number of places in the whole number parts of the factors would be 1 and 3, respectively, and the answer should have $1 + 3$, or 4 places, and would be 1,110.

A common mistake of beginners with the slide rule is to learn the method of doing all the leading operations before acquiring any practice to speak of. This is an error, as a beginner adopting that method will soon find himself swamped with undigested information, and a long time will be consumed in acquiring confidence in the determinations. The proper plan is to stop study right here, and make no effort at learning division, or any other operation, until full command is obtained of multiplication, and entire confidence is felt in the results of multiplication. When this is accomplished, division should be taken up in the same way, and following that, the other applications. The principle of the rule having been learned at the beginning, each successive step will be shorter than the preceding one, and the learner will soon find himself in full

and confident command of the resources of the instrument.

Note—It has been found to be impracticable to cover the ground of these articles in three numbers as at first intended and additional parts will therefore appear.

▲ ▲ ▲

Some Compressed-Air Victims.

BY FRANK RICHARDS.

It seems to be quite well settled that in the near future we are to see and hear much more of the use of compressed air than in the past. We hear of arrangements in two or three cities for practical tests of air-propelled street cars. It is certainly time that a fair and complete trial of its capabilities in this line were made, and it is singular that no such trial has yet been made—at least in this country. Cars driven by compressed air are running constantly in Paris and some other European cities, and may be considered a permanent success there; but even these cannot be considered to have satisfactorily settled the entire problem.

It is a noticeable fact that while some outrageous failures have been scored against compressed air, they have been of such a character that they have left absolutely no implication against the practicable and profitable employment of the air under suitable and easily attainable conditions. Some curious things are on record in connection with compressed air, and it has been in a peculiar manner a victim of circumstances.

The "atmospheric" railway was one of the first things in the mechanical line that I ever heard of. It was a scheme of half a century ago, in England, for propelling railway trains by compressed air. The air pressure proposed to be employed was not high, but it was in every respect a bona fide compressed-air job. Between the rails a continuous pipe was sunk, the top of it coming to nearly the level of the rails. The pipe, as I recollect it, was about a foot in diameter, with a continuous slot, like the slot of the cable road, running the entire length of the system. The slot was to be closed internally by a leather strip forming a continuous valve; then a piston was to traverse the tube and be attached to the car, the air pressure against the piston driving the car. As the piston moved along, provision was made for opening the slot by drawing in the strip of leather at the point where the piston was attached to the car, and for closing the slot air-tight again after the piston had passed. To the experienced railroader of to-day this plan would present some serious practical difficulties, especially in the way of switching, and of running cars in close succession; but these difficulties were never actually encountered. The railway never got into operation, but was defeated by a different cause. There was plenty of money provided, and quite a length of line was laid, while I personally saw a big pile of pipes stored in a railway yard which were never laid down. It was found that it would be entirely impossible to run the railway as proposed on account of the field mice. The leather valve for the slot was soaked and covered with tallow, and the mice so continuously nibbled at the leather that it was impossible to keep it in working condition, and this it was that defeated the "atmospheric" railway. It was a damaging blow to compressed air for the time; but, of course, the air had nothing to do with it. This was before the india-rubber days, and we would at the present day probably be able to defeat the field mice.

The above, it will be noticed, was one of the slot schemes, and a slot in a railway seems to be capable of absorbing a vast amount of money. It happened that at one time I was so situated as to know nearly all that there was to be known of another railway slot into which quite a sum of money was poured, and none of it ever fished out again. I allude now to the Judson Pneumatic Railway system. There are not many who really know what the features of this system were, and why it was such a complete failure. It was not in any sense a compressed air or pneumatic affair, but was simply an absurd mechanical contrivance that might have been driven by anything as well as by anything else.

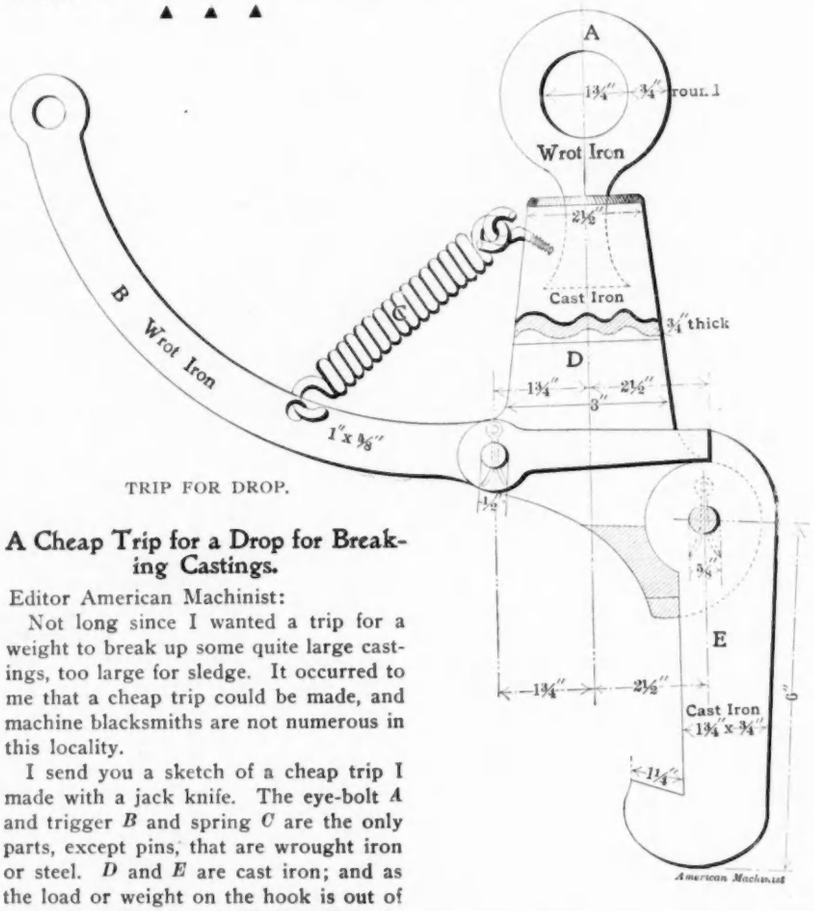
The road, as was said, was one of the slot kind. Down, say, 2 feet below the slot, or the street level, was a continuously revolving drum, and all the power transmitted was first employed in driving this drum. The drum was made of heavy iron pipe, 10 inches diameter, and in lengths of 10 or 12 feet. Each drum was bored out at each end, and malleable iron heads were turned and fitted and pinned in. Each head had a journal, and outside the journal one-half of a clutch. From the construction it is apparent that the drum could not be driven from one end, or if of any considerable length, even from both ends, because it would twist off in one of the journals, and here is where the pneumatic part of it came in. Small stationary engines were to be placed at intervals along the line at the side of the track, driven by compressed air and geared to the drum, to help to keep it going. The cost of line construction was considerably higher than, and perhaps double that of any cable road.

Then, the car mechanism was "ingenious," complicated and costly. It was of the character of the host of possibilities of mechanical arrangement which throng to every inventor's mind, only to be immediately rejected where an intelligent judgment sits in control. Imagination without experience or judgment is continually foisting these crudities upon a too credulous public. An iron framework, traversing the conduit above the drum, was connected to the body of the car by rods up through the slot. In this frame were four friction wheels about 9 inches diameter and 4 inches thick, with wooden faces to run in contact with the revolving drum. Means were provided for changing the pressure of these friction wheels upon the drum, and also for changing the angle of the plane of revolution of the wheels. Supposing the plane of the wheels to be at right angles to the axis of the drum, the wheels would simply revolve and have no effect upon the car. If, however, the wheels were set at an oblique angle to the drum, then their tendency would be to follow a helical path along the drum, and by that means to propel the car along the track. That was the whole idea of the Judson "Pneumatic" Railroad. The speed of the car would vary with the angle of the wheels, and as the angle could be changed to either side of the right angle, the car could be made to run in either direction by the motorman. The wheels also, when set at right angles, would operate as a more or less efficient brake, so that altogether it could be operated to make quite a show before an unmechanical crowd. In the basement of a large building in New York a track was laid and a revolving drum was put in, and a rough car was run over the track, and investors could come and see that it would actually go. If a thing will actually go, and if it is sufficiently outrageous in its departure from established practice, there is always money obtainable to back it. In the exhibition referred to, no conduit was built, and no slot was encountered, and nothing was done to show how the cars could be switched, so that it was never operated under practical conditions. The revolving drum was actually driven by a steam engine operated by compressed air; but the same engine might as well have been operated by steam, only thus there would have been no "pneumatic" feature about it. The wooden friction wheels having only a small and changing point of contact with the drum, of course, wore out rapidly, requiring renewing after two or three miles run. They were made in sections of hardwood, with the grain placed radial, and clamped between iron plates, costing two or three dollars for each renewal. A stockholder, in my hearing, asked a promoter about how these wheels would wear, and he was told that they would each stand probably a month's service, and that then they could be renewed at a cost of about three cents. And this company at one time had three hundred thousand dollars in cash in its treasury. Later, a mile or so of track was laid in fine style, in Washington, and a costly air-compressing plant was erected; but the cars very properly refused to run, while the contractors and those who had furnished material were ultimately badly victimized.

At the present moment, and not many miles from New York, there is another compressed-air scheme, not a railroad, being worked out in a very costly fashion, but predestined also to ignominious fail-

ure. Of this scheme it is not worth while to speak here in detail. It is sufficient to say that it is a perpetual motion scheme with power to let. It will not only run itself after it gets started, but it will have a lot of surplus power for driving other machinery. A steam engine is employed to work a series of air-compressing cylinders, and after these are in full operation, the steam engine will not be wanted, as the recompression of the air is to more than supply all the power. Money for such schemes seems to be always procurable, and by such schemes the good name of compressed air has been badly smirched.

▲ ▲ ▲



TRIP FOR DROP.

A Cheap Trip for a Drop for Breaking Castings.

Editor American Machinist:

Not long since I wanted a trip for a weight to break up some quite large castings, too large for sledge. It occurred to me that a cheap trip could be made, and machine blacksmiths are not numerous in this locality.

I send you a sketch of a cheap trip I made with a jack knife. The eye-bolt *A* and trigger *B* and spring *C* are the only parts, except pins, that are wrought iron or steel. *D* and *E* are cast iron; and as the load or weight on the hook is out of center line 2¼ inches, it is held sufficiently secure until you pull *B*, and it drops the weight dead true. The weight I used is 402 pounds. Pattern for weight was a good-sized water pail, swept out on the larger end to have a convex face, and it worked fine. I have broken a large amount of quite heavy scrap with the rig. The ball falls 20 feet. I keep extra hooks *E* on hand should one break, but so far I have not broken one.

L. C. JEWETT.

▲ ▲ ▲

Owing principally to the apparently small chance of getting obstructive legislation removed in time, "The Engineer" announces that its eleven hundred guinea prize horseless carriage competition will not take place until 1897.

Commercial Review.

NEW YORK, SATURDAY EVENING, JUNE 13TH.

Dynamos and Motors.

The following are some items of news which have of late been reported concerning the electrical machinery trade: The stockholders of the Westinghouse Electric & Manufacturing Company, at a meeting held June 4th, have approved of a proposition to increase the stock of the company from $10,000,000 to $15,000,000. The plant of the Niagara Falls Power Company is to be extended, with the addition of seven 5,000 horse-power generators of Westinghouse make, the greater part of the new power being intended for use in Buffalo. An electrical company known as the Walker has been organized, under the laws of New Jersey, with the intention, it is said, of buying up the present well-known company of that name, of Cleveland, besides other substantial concerns. Some interest was aroused in what seemed a formidable rival of the General Electric, speculation in the stock of the latter company being slightly affected thereby. But reports concerning the new company have been contradictory.

The electrical machinery market has not improved in the past month, and trade in dynamos for incandescent lighting is considerably easier. Among the new buildings in this city for whose electrical equipment the placing of contracts is not yet reported, are the Bank of Commerce, the New York Athletic Club and the Waldorf Hotel.

A feature of the past month with the General Electric Company has been the electrical transmission of water power, in connection with which several projects have been on foot and the result of one definitely announced. It consists in the transmission of 5,000 horse-power from a distance of eleven miles into the city of Lima, Peru, to be used for running 20,000 incandescent lights, 1,200 arc lights and 100 cars. Apropos to this subject, it may be mentioned that a street railway company near one of the cities of this State propose to move their power plant

(Continued on page 21.)

▲ ▲ ▲

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Position wanted by pract. mach. & tool maker, experienced in handling men and making piece work prices. West of Pittsburg pref. BOX 165, AM. MACH.

First-class tool maker wants situation in vicinity of Cleveland or Buffalo; at present employed in Chicago. Address, BOX 170, AMERICAN MACHINIST.

Wanted—Position by compt. mech. draftsman, American, 10 yrs.' exp., tech. education, references, reasonable wages. BOX 167, AMERICAN MACHINIST.

Salesman and engineer, located at Chicago, wants to represent builder of first-class high and low speed engines; also water tube boiler. Address BOX 161, AMERICAN MACHINIST.

Technical educated draftsman with 3 yrs.' shop experience, wants position in drafting office or light machine work; also has knowledge of photography. Address, BOX 168, AMERICAN MACHINIST.

Wanted—An experienced foreman for machine shop in a Western City. One thoroughly acquainted with elevator work and hoisting machinery. Address, BOX 169, care AMERICAN MACHINIST.

Wanted—A millwright; a good general mechanic to attend to repairs at a factory near New York; state wages expected, age, and nature of previous experience; steady employment to a good man. Address P. O. Box 2324, New York.

Wanted—By a designer and practical mechanic, a position as superintendent or assistant; has had a large exp. in designing and building auto. wire and sheet metal mach.; also, sewing mach. and typewriter work. BOX 171, AMERICAN MACHINIST.

Superintendent of foundry and machine works desires to make a change. Has had technical education and excellent experience as draftsman, inspector, engineer of tests and supt.; can furnish first-class references. BOX 164, AMER. MACHINIST.

Wanted—Foreman of engine department; must be familiar with building high-speed engines, making parts interchangeable; every opportunity for advancement for the right man, who will properly apply himself and turn out work accurately and rapidly. Box 260, Buffalo, N. Y.

Wanted—By a large steam engine company, a first-class man to assume charge of their sales department; a graduate of technical college preferred. Must be familiar with the best of modern high grade engines and successful in securing business. Address, with refs., BOX 172, AMER. MACH.

Pattern maker wishes pos. as foreman. First-class on gen. mach.; strictly temperate and reliable; competent to assume charge of men, & keep mach. in good order. 11 yrs.' exp. in various branches of wood work; age 29. Eastern or Atlantic states preferred. Address, BOX 166, AMERICAN MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Machine forgings to order; special facilities for doing good work quick; send for estimates. The Coulter & McKenzie Machine Co., Bridgeport, Ct.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call or get list 17 B. The Garvin Mach. Co., 440 Canal st., N. Y.

VALUABLE BOOKS

For MACHINISTS, ENGINEERS, ELECTRICIANS, Etc.

Our catalogues of Books, on the above subjects, as well as every other practical subject, sent free to any address.

☞ See our detailed advertisements of special books in recent numbers of AMERICAN MACHINIST.

NORMAN W. HENLEY & CO.,
15 Beekman Street, NEW YORK.

ROLLS,
INGOT MOULDS,
IRON CASTINGS,

Light and Heavy.

Also Brass and Copper Castings.

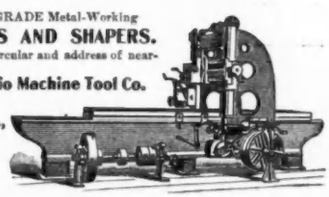
• • •

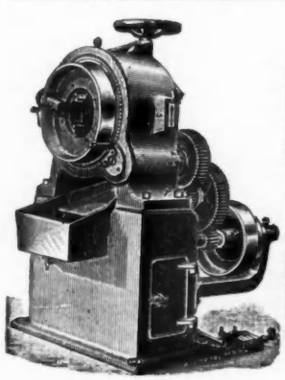
Write for Estimates.

• • •

The Lorain Foundry Company,
LORAIN, OHIO.

HIGH GRADE Metal-Working
PLANERS AND SHAPERS.
Write for circular and address of nearest agent.
The Ohio Machine Tool Co.
600 South Leighton St.,
KENTON, OHIO.

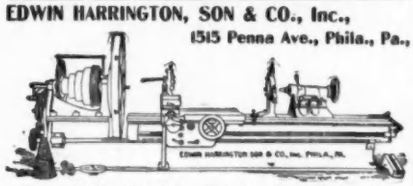




CURTIS & CURTIS,
66 CARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting and Threading Machinery, FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

WIRE **THE WATERBURY MACHINE CO.,**
Waterbury, Conn.,
Owners U. S. Patents Bolton Continuous Drawing Machinery. Modern machines for drawing all kinds and sizes of wire by multiple dies.

EDWIN HARRINGTON, SON & CO., Inc.,
1515 Penna Ave., Phila., Pa.,



Extension Lathes, Drill Presses, Traveling Cranes, Chain Hoists.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N. Y.

Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.

Thomas A. Edison

FOR SALE.

One "White & Middleton" 15 H. P. Gas Engine, in use only about six months, in first-class condition, and can be seen in operation, and satisfactory reasons given for selling.

THE PORT CHESTER BOLT AND NUT CO.,
PORT CHESTER, N. Y.

Upright Drills

and General Line of Machine Shop Tools.

HILL, CLARKE & CO.
160 Oliver Street, BOSTON.
16 S. Canal St., Chicago.

Montgomery & Co
Have everything
a Machinist requires.
Our address is
105 Fulton Str.
New York City

Robert Tiles

RUST **TOOLS**

unless well protected. You can protect any bright metal surface absolutely and under all conditions against rust by using

MANNOCITIN.

Firms which you know pronounce it

"The Best Rust Preventive."

Pamphlet tells all about it.

OTTO GOETZE, 116 Broad Street, New York.

(*Continued from page 20.*)

some eleven miles, to a source of water power, thus to compete with a power which costs $30 per horse-power.

What is true of dynamos in respect to the easier trade of this month is generally conceded to apply also to motors, and it has been remarked that those for running fans are in better selling than their more consequential relatives.

From the standpoint of the C. & C. Electric Company, however, the situation has for some time past been visibly improving. It is true they do not find the activity startling, and prices are close, but their orders have so far increased that about a week ago the working hours in their new shops were fixed to last until 9 P. M. for a period of 90 days to come. The motor trade is what they find particularly good, and the cause assigned for this is that the slowing down of the larger industries has started a number of smaller new ones, which use motors for their power.

At this season of the year, quite a good deal of extension work is being done on street railways, in various parts of the country, and we understand that the Walker Company, of Cleveland, are among the especially busy ones.

A favorable report of business comes from the Warren Electric Company. They say: "We find the present trade situation in dynamos very much improved over what it was a year ago, and slightly better than it was a month ago. The Warren Alternator sales have increased more than 500 per cent. over last year. The class of trade that we are furnishing largely is central station and isolated plants. We hope that after the St. Louis convention there will be some very material improvement in general business."

The Holtzer-Cabot Electric Company write: "We are doing the same amount of work now that we did last year at this time, and have from January 1st up to the present time done fully as much work as we did for the corresponding months last year."

But to put the case broadly, the electrical trade is not now moving in the direction of activity, or in the words of one well qualified to judge: "Business is very flat, and prices are awfully low." If figures have not everywhere been more ruthlessly cut during the last month than before, their demoralization is, at least, more generally felt. They long ago had reached the bottom, and seem to have fallen through. It is difficult to conjecture what may be their further downward possibilities. We are reminded of the earth's resting on the back of a tortoise, the tortoise on a rock, that on another rock, and there being, in fact, rocks all the way down.

Iron and Other Metals.

The same listless, stagnant spirit dominates the iron market. Of late, prices of

pig iron have had a softening tendency. Business in pig tin has not attained heavy proportions this week, in this market, but in London there has been considerable trading. Early in the week a decline in price occurred, but the figures have become higher toward the close. It is said that we are now about entering upon a quiet season, many of the larger consumers closing to take inventory.

Copper, notwithstanding a somewhat inactive business transacted in this market, has been bullish in tone; London values for Lake Superior Ingot attaining a point higher than they have reached for more than a year. The shipments of copper to Europe have been heavy, amounting to about 2,600 tons.

Pig lead has been dull and easy, in this quarter, although more activity is reported in the West.

We may add, under date Monday, June 15th, that tin has made a notable advance, on the strength of foreign quotations, and copper is also strong in price.

Quotations.

NEW YORK, Monday, June 15th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50 @ $13 25
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 00 @ 11 50
Gray Forge	10 75 @ 11 00
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	11 00 @ 11 50
No. 3 foundry, Southern	10 75 @ 11 00
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, Southern	10 25 @ 10 50

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.10 @ 1.20c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11¾ @ 12c.; electrolytic, 11⅝c.; casting copper, 11 @ 11⅛c.

Pig Tin—Higher on foreign cables. For 5 and 10-ton lots, about 13¾c. f. o. b. estimated.

Pig Lead—In carloads, 3.00., f. o. b.

Spelter—In carload lots, New York delivery, 4.05 @ 4.12½c.

Antimony—Cookson's, 7⅛ @ 7¾c.; Hallett's, 6⅛ @ 6¾c.; Japanese, 6⅛ @ 6⅝c.

Lard Oil—Prime city, present make, 43 @ 45c., according to quantity.

▲ ▲ ▲

Manufactures.

Messrs. Hogan Bros., Fort William, Ont., Canada, are intending to build a planing mill.

A company has been formed at Meadville, Pa., for the manufacture of the Luce automatic car brake.

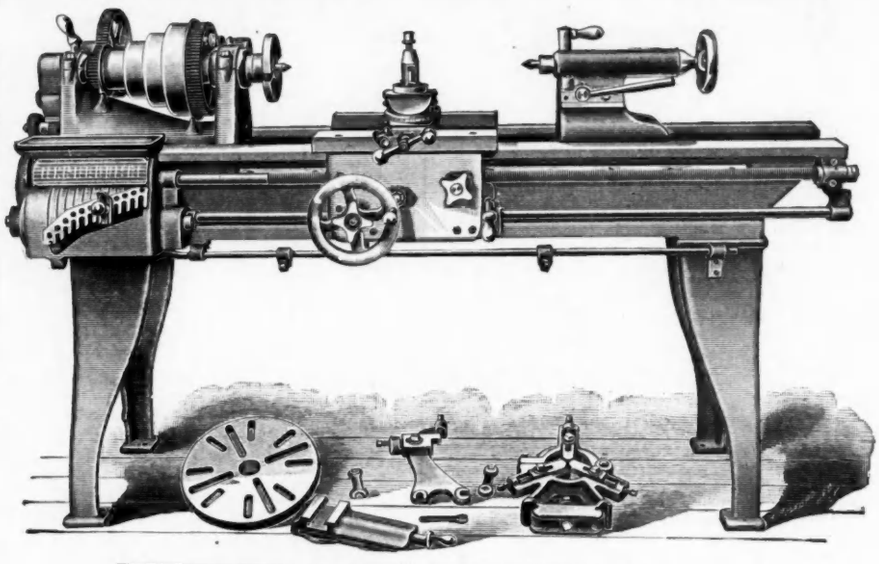
The British Columbia Iron Works, Vancouver, B. C., propose to put in new machinery to the extent of $100,000.

An order in council has been passed for expending $30,000 for waterworks improvements at Chatham, Ont., Canada.

At Norfolk, Va., a plant will be erected by the Norfolk Gas and Electric Co. This is a recently formed company with a capital of $500,000.

The Q. & C. Co., Chicago, Ill., have received an award and a gold medal on their exhibit of metal sawing machinery and tie plates at the Atlanta Exposition.

Lake Superior Power Co., Sault St. Marie, Ont., Canada, intend to establish a plant for the reduction of ores by electricity and the manufacture of calcium carbide.



14 in. x 6 ft. Hendey-Norton Lathe with Improved Automatic Stop.

THIS Lathe COMBINES the LATEST and BEST Improvements. Automatic Stop. It is Simple, Durable, Indispensable. It will AUTOMATICALLY STOP the Carriage in EITHER direction. It is equally efficient whether FEEDING or THREAD-CUTTING. Running up to a shoulder, boring to BOTTOM of holes, or INTERNAL THREAD-CUTTING.

No danger of spoiling either tool or work. It is a safeguard against accidents, in either direction.

Feeds—It has all feeds in daily use with simple movement of lever.

Threads—It has all threads in daily use with simple movement of lever.

Carriage—The carriage reverses in Apron. No slamming of Countershaft. There is no comparison between this Lathe and the old style or common Lathe. Quick work, rapid changes, satisfactory results. BUY THE BEST.

SEND FOR CIRCULAR.

The Hendey Machine Co.

TORRINGTON, CONN.

European Agents:

CHAS. CHURCHILL & CO. (Ltd.),
21 Cross Street, Finsbury, London.

SCHUCHARDT & SCHUTTE,
59 Spandauerstrasse, Berlin.

SOLLER, Basel, Switzerland.

Pratt & Whitney Co. HARTFORD, CONN., U. S. A.

MAKERS OF

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

ENGLAND—BUCK & HICKMAN, 280 Whitechapel road, London, E.; CHAS. CHURCHILL & CO., LTD., 21 Cross st., Finsbury, London, E. C.
FRANCE—FENWICK FRERES & CO., 21 Rue Martel, Paris; F. G. KREUTZBERGER, 140 Rue de Neuilly Puteaux (Seine).
CHICAGO—42 and 44 S. Clinton st. BOSTON—281 Franklin st. NEW YORK—123 Liberty st

SHELL AND SOLID REAMERS,

WITH PAT. SPIRAL FLUTES.

Arbors, Mandrels, Taps, Dies, Screw Plates, Tap Wrenches, Bolt Cutters, Drilling Machines, Etc.

Wiley & Russell Mfg. Co., SEND FOR CATALOGUE.
GREENFIELD, MASS., U. S. A.

THE STORY OF A KEY-WAY—IN SEVEN ACTS.

ACT SIX—"Finished at Last."

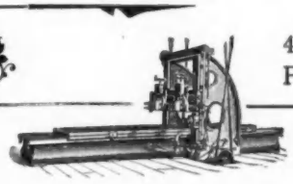
CONTINUED NEXT WEEK.

NEW ENLARGED EDITION.

"The Boston Machinist." By WALTER FITZGERALD. 12MO, CLOTH, $1.00.

John Wiley & Sons, 53 East 10th Street, New York.

Shapers



48 Inch Planer.

- Immediate delivery on 12, 14 and 16 in. Stroke.
- Manufacturers of other Fine Machine Tools.
- Send for Catalogue "E."

Fitchburg Machine Works, Fitchburg, Mass.

The Berlin Iron Bridge Company, of East Berlin, Conn., has a contract for furnishing steel trusses for the new building which is to be erected by the Holyoke Gas Company, of Holyoke, Mass. The building is 50 feet wide and 60 feet long.

The Sharon Iron Works, of Sharon, Pa., will build a mammoth steel department, with a capacity of 1,500 tons per day, to its works. It will cost over $500,000. They also will add a department for the manufacture of rods and wire out of steel.

The town of Strathroy, Ont., Canada, have carried a by-law granting a bonus for a furniture factory. Messrs. Smyth and Merrett are the interested parties. This will be a new industry; ground has been secured and the building is under way.

The Pittsburgh, Wheeling & Lake Erie R. R. will open one of the largest coal mines in Eastern Ohio, near Martin's Ferry. A complete electric plant will be installed for the rapid mining of coal by the electric method, giving employment to 300 men.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting proposals until June 20th for furnishing the New York Navy Yard with one moderate speed dynamo and other electrical apparatus and supplies for the New York Navy Yard.

A $25,000 company, under the title of the Toronto Brass Co., Ltd., to manufacture articles of iron, steel, copper, brass, bronze and other metals, with Thomas H. Stephenson, Chas. Mulvey and Thomas Mulvey as first directors, and place of business Toronto, Ont., are asking for a charter.

Messrs. Jones & Laughlins are building an immense blooming mill at Pittsburgh, Pa. The engines to drive the mill will develop 10,000 horsepower. This firm are also going to replace their two 7-ton converters with ones of 10 ton capacity. This new mill will be the largest in the country.

The Thomas Mfg. Co., of Springfield, O., have decided to increase their bicycle business, and R. C. Fay, formerly superintendent of the Remington Arms Co., Ilion, N. Y., has been engaged as manager. They are now making arrangements to provide more room, and will install new machinery for the manufacture of bicycles.

At Syracuse, N. Y., the power station in Tracey street is to be considerably enlarged. An addition 70 x 100 feet is to be made. Two generators of 1,000 horse-power each are to be added, and each of them will be operated by an engine of the same power with direct connection. Four large boilers will also be added to the five now in the station.

J. A. Fay & Co., Cincinnati, O., recently received a very large order from Yokohama, Japan. This order consists of a complete outfit for their government railroad shops. This is the largest order ever given by them for an outfit of wood-working machinery, and it has attracted much attention, as these shops are intended to be the finest in the East.

The Cincinnati Forge & Iron Company is going to build a plant at Carthage, near Cincinnati, Ohio, that is to cost over $100,000. The plant will be one of the largest of its kind in the country. The buildings will be constructed of brick and iron and will include a forge and hammer shop 350 x 120 feet, a rolling mill of the same size, and a machinery shop 150 x 70 feet in size.

▲ ▲ ▲

Index to Advertisers.

	PAGE
Abbott, Wheelock & Co.	27
Acme Machinery Co.	Cover
Adams Co., The	38
Adt & Son, John	29
Akron Belting Co., The	24
Albro-Clem Elevator Co.	38
Almond, T. R.	32
American Gas Furnace Co.	30
American Injector Co	26
Ames Iron Works	40
Arcade File Works	34
Armstrong Bros. Tool Co.	30
Armstrong Mfg. Co., The	Cover
Aurora Tool Works	38

(Continued on page 24.)

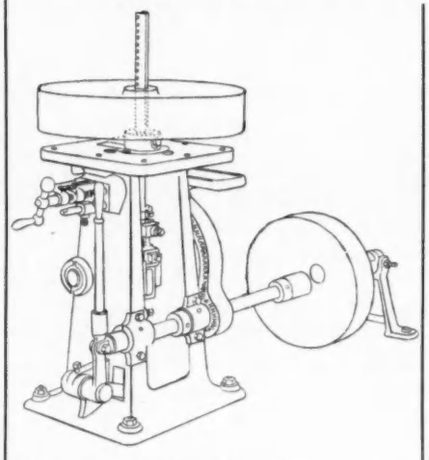
INDEX TO ADVERTISERS—Continued.

	PAGE
Backus Water Motor Co	40
Bacon, L. Seward	35
Baird & Co., Henry Carey	27
Ball-Bearing Co., The	26
Barker & Co., William	24
Barnes Co., W. F. & John	25
Bates, Henry H	30
Baush & Harris Machine Tool Co.	Cover
Besly & Co., Chas. H	35
Bethlehem Foundry and Machine Co	30
Betts Machine Co	25
Bickford Drill and Tool Co	33
Bignall & Keeler Mfg. Co	27
Bilgram, Hugo	35
Blaisdell & Co., P	27
Bliss Co., E. W	30
Boston Gear Works	24
Bradford Mill Co., The	28
Bremer Machine Co., Godfrey J	33
Brown & Sharpe Mfg. Co	Cover
Buffalo Forge Co	Cover
Builders Iron Foundry	31
Bullard Machine Tool Co	37
Burr & Houston Co	27
Cincinnati Milling Machine Co.	Cover
Cleveland Machine Screw Co	38
Cleveland Twist Drill Co	31
Coburn Trolley Track Mfg. Co., The	26
Coffin & Leighton	26
Comstock, Wm. T	30
Consolidated Safety Valve Co., The	Cover
Conover Mfg. Co	32
Cooke & Co	29
Correspondence School of Technology	39
Crescent Steel Co	27
Curtis & Curtis	21
Cushman Chuck Co	35
Dallett & Co., Thos. H	28
Davis, W. P	Cover
Davis & Egan Mach. Tool Co	39
Dawson & Goodwin	37
Deane Steam Pump Co	Cover
Detrick & Harvey Machine Co	33
Diamond Machine Co	35
Dietz, Schumacher & Boye	35
Dixon Crucible Co., Joseph	39
Dwight Slate Machine Co	39
Dyer & Driscoll	21
Elliott Chemical Works	38
Engineering News Pub. Co	25
Erlandsen, J	21
Evans Friction Cone Co	33
Fay & Co., J. A	32
Ferracute Machine Co	24
Fifield Tool Co	Cover
Fish Machine Works, H. C	25
Fitchburg Machine Works	23
Flather & Co	39
Foote, Barker & Co	24
Forbes & Co., W. D	28
Fox Machine Co	35
Frick Co., The	40
Garvin Machine Co., The	29 and Cover
General Electric Co	32
Goetze, O	21
Goodyear, S. W	38
Gould & Eberhardt	24
Grant Calculating Machine Co	26
Gray Co., G. A	Cover
Harrington & King Perforating Co., The	Cover
Harrington, Son & Co., E	21
Hartford Steam Boiler Insp. and Ins. Co	24
Hendey Machine Co	22 and Cover
Henley & Co., N. W	21
Hill, Clarke & Co	21
Hoggson & Pettis Mfg. Co	35
Horton & Son Co., E	33
Hurlbut-Rogers Machine Co	Cover
Hyatt Roller Bearing Co	31
Ingersoll Milling Machine Co	38
International Correspondence Schools, The	39
Jenkins Bros	24
Johnson Co., The	27
Johns Mfg. Co., H. W	Cover
Jones & Co., B. M	33
Jones & Lamson Machine Co	Cover
Kelly & Jones Co., The	40
Keuffel & Esser Co	35
Keystone Engine and Machine Works	40
King Mfg. Co	27
Landis Bros	38
LeCount, Wm. G	27
Leland & Faulconer Mfg. Co	31
Lodge & Shipley Machine Tool Co	Cover
Long & Allstatter Co	32
Machinists' Supply Co	26
Maris Bros	Cover
Mason Regulator Co	39
McCabe, J. J	29
McFadden Co	26
Miner & Peck Mfg. Co	Cover
Mitts & Merrill	24
Montgomery & Co	21
Morse Twist Drill & Machine Co	31
Mossberg Mfg. Co	28
National Chuck Co	35
National Machinery Co	27
National Pipe Bending Co	37
New Doty Mfg. Co	Cover
New Haven Mfg. Co	32
New Process Raw Hide Co., The	38
Newton Machine Tool Works	Cover
Nicholson File Co	28
Niles Tool Works Co	Cover
Niles Tool Works Co., N. Y. Branch	29

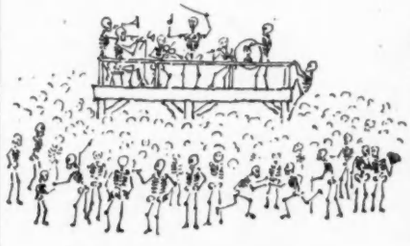
(*Continued on page 25.*)

WHEN YOU ARE OFFERED JENKINS' or JENKINS BROS.' DISCS that have Trade Mark same as cut, they are all right for high pressure steam. All others are imitations and you cannot hold us responsible. If you cannot get our discs from your dealer, send to us for them.

JENKINS BROS., 71 John Street, New York.
31 N. Canal St., Chicago. 117 N. 4th St., Philadelphia. 105 Milk St., Boston.



Here's a Key Seater to Beat the Band



MITTS & MERRILL,
913 Tilden Street,
Saginaw, Mich.

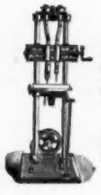
BOOKLET FULL OF HARD, COLD FACTS ON KEY SEATERS, AND POINTING A WAY TO SAVE A DOLLAR. COSTS A POSTAL.

THE TAYLOR-RICE ENGINEERING CO.,
Works: Gloucester City, N. J., U. S. A.

Adjustable Shell Reamers

5/16 in. to 5 in. Send for New Pamphlet.

SHAPERS GOULD & EBERHARDT, NEWARK, N. J.

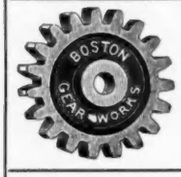


Special Machinery.
Adjustable 2-Spindle Drill Presses
Cutter Grinders. Cock Grinders. Correspondence Solicited.
Send for Photos or Blue-Prints.
FOOTE, BARKER & CO.,
49 "A" Wood St., Cleveland, O.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

"AKRON" BELTING
is guaranteed for the most exacting service. Defective Belts Replaced Free.
THE AKRON BELTING CO.
Manufacturers of Belting and Mill Supplies.
AKRON, OHIO, U. S. A.
Valuable Hand-Book Free.

SPECIAL PRESSES AND DIES
FOR ALL KINDS OF BICYCLE WORK.
FERRACUTE MACHINE CO.
New Catalogue. BRIDGETON, N. J., U. S. A.

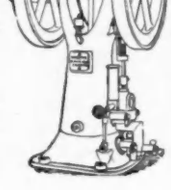


FRANK BURGESS, Proprietor.
35 Hartford Street, Boston, Mass.
1,100 Sizes Spur, Bevel, Spiral, Worm, Rack, Elliptic, Internal, etc.
Send for Catalog.

CENTER GRINDERS,
WILLIAM BARKER & CO., Mfrs.,
IRON AND BRASS WORKING MACHINERY,
CINCINNATI, OHIO.

COMBINED DRILL AND COUNTERSINK
FOR CENTERING LATHE WORK.

J. T. SLOCOMB & CO.,
PROVIDENCE, R.I. U.S.A.



This beats Wind, Steam or Horse Power.
We offer the
WEBSTER 2 1-2 ACTUAL HORSEPOWER
GAS ENGINE
For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
☞ *Write for Special Catalog.*
WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

D. SAUNDERS' SONS

21 Atherton St., Yonkers, N.Y.

▲▲▲

Makers of Pipe-Cutting, Threading and Tapping Machines.

▲▲▲

Pipe Cutter Circular for the asking.

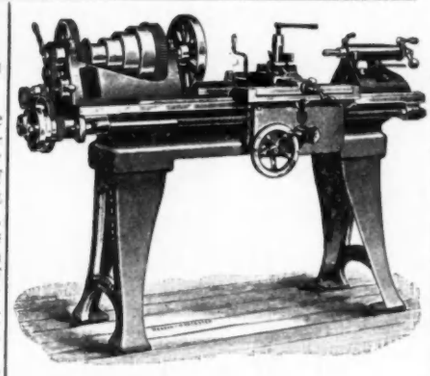
Patent Wheel Pipe Cutter

shown above combines simplicity with strength and lightness. Easily adapted to various sizes of pipe, rolling instead of sliding motion, no loose parts to become detached and mislaid. All wearing surfaces are of tool steel, hardened. Less friction of parts than any other pipe cutter made.

A BOOK OF TOOLS.

Of course any one knows where to buy the common, everyday things. "A Book of Tools" tells all about them. The uncommon, every-other-day things you don't know so much about, and "A Book of Tools" tells lots about them. It isn't a very big book, but it contains a great deal, and is in valuable to the buyer and user of all kinds of Tools, Machinery and Supplies. It contains 550 pages and upwards of 2,000 illustrations, and will be sent post-paid to any address upon receipt of 25 cents in stamps.

CHAS. A. STRELINGER & CO.,
DETROIT, MICH.



Bargains in 14 in. Lathes.

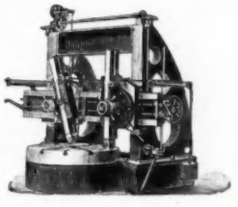
Circulars on Application.

H. C. Fish Mach. W'ks, Worcester, Mass.

MODERN MACHINE TOOLS

Constructed from designs embodying all the late improvements in economy, manipulation, strength and accuracy.

BETTS MACHINE CO., Wilmington, Del., U.S.A.



ENGINEERING CONTRACTS
... AND ...
SPECIFICATIONS,

Including Law of Contracts and Examples of General and Technical Clauses.

By Prof. J. B. Johnson, M.I.C.E., M.A.S.M.E, M.A.S.C.E., Etc. 8vo., Cloth; pp. 417 x VII and an Index. Price, $4.00.

"Completeness characterizes the book and it readily takes an authoritative position on the subject with which it deals."—*Manufacturers' Record.*

"Each of the four divisions of this work is systematically treated in such a manner as to make the book very useful to an engineer or manufacturer who has anything to do with contracts for engineering constructions."—*American Machinist.*

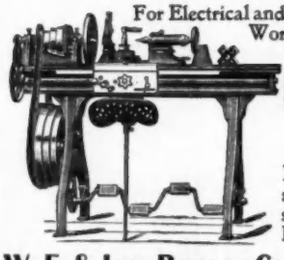
"The first part is a most desirable addition to an engineer's library, the arrangement appearing to be both concise and complete. The details of advertising for bids, guarantees, forms of proposal, etc., which constitute part second, contain many suggestions and ought to prove very useful. . . . . This work is certainly one of the most interesting that could be added to the library of the engineer."—*Electrical Engineering.*

"Professor Johnson's 'Engineering Contracts and Specifications,' falls into the category of valuable, and, after a short acquaintance, indispensable engineer's reference books; plainly and tersely written, excellently arranged, conservative in statement and for the most part treating the subject matter thoroughly, it is unique in that, while appealing more directly to the engineer and the student, it is, nevertheless, almost as necessary to the contractor and the purchaser. . . . The book abounds in valuable suggestions and sound advice. . . . The omissions, and they are few, are easily condoned in the pleasure and profit one derives from Professor Johnson's thorough treatment of an important subject hitherto much neglected and about which there has been little information in an available or logical form."—*Electrical World.*

Sent postpaid on receipt of price by the publishers.

THE ENGINEERING NEWS PUBLISHING CO.,
101-105 Tribune Building, New York.

Foot Power Lathes



For Electrical and Experimental Work, Gunsmiths, Tool Makers and General Machine Shop Work.

High Grade, Elegant in Design. Better send for Lathe Book.

W. F. & Jno. Barnes Co. 1995 Ruby St., Rockford, Ill.
England, Chas. Churchill & Co., Ltd. London, E.C.

ROSE POLYTECHNIC INSTITUTE. Terre Haute, Ind.

A School of Engineering. Mechanical, Electrical, Civil Engineering, Chemical Courses. Well endowed. Extensive Shops and Foundry. Modernly equipped Laboratories in all departments. Expenses low. Address, C. L. MEES, President.

Automatic Solid Die Bolt.

THREADING MACHINES.

Two Styles. Four Sizes.

Send for Catalogue "A."

WEBSTER & PERKS TOOL CO.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.

INDEX TO ADVERTISERS—Continued.

	PAGE
Nolte Brass Co.	35
Norman Co., J. J.	40
Norton Emery Wheel Co	31
Ohio Machine Tool Co., The	21
Oneida Mfg. Chuck Co.	35
Otto Gas Engine Works	40
Peerless Drilling Compound Co., The	30
Penberthy Injector Co.	38
Pierce Engine Co	40
Place Machine Co., George	29
Port Chester Bolt & Nut Co	21
Pratt & Whitney Co.	23
Pratt Chuck Co.	35
Prentiss Tool & Supply Co.	36
Pryibil, P.	32
Quint, A. D.	35
Q. and C. Co.	33
Rand Drill Co	31
Reed Co., F. E.	33
Replogle Governor Works, The	32
Roots, P. H. & F. M.	Cover
Rose Polytechnic Institute	25
Roth Bros. & Co	27
Saunders' Sons, D	25
Sawyer Tool Co.	27
Sebastian Lathe Co.	26
Sebastian-May Co.	27
Sellers & Co., Inc., Wm.	Cover
Seneca Falls Mfg. Co.	30
Shriver & Co., T.	32
Skinner Chuck Co.	35
Slocomb & Co., J. T.	24
Springfield Gas Engine Co., The	40
Standard Tool Co.	35
Stark, John	37
Starrett, L. S.	37
Stiles & Fladd Press Co., The	30
Sterling Emery Wheel Mfg. Co.	32
Stirling Co., The	39
Stover Novelty Works	39
Strelinger & Co., Chas. A.	25
Sturtevant Co., B. F.	37
Taunton Locomotive Mfg. Co.	37
Taylor-Rice Engineering Co.	24
Timolat, J. G.	40
Toledo Machine & Tool Co.	28
Toomey, Frank	20
Transue & Williams	37
Trenton Iron Co., The	38
Trump Bros. Machine Co.	31
Warner & Swasey	Cover
Waterbury-Farrel F'dry & Mach. Co.	Cover
Waterbury Machine Co., The	21
Watson-Stillman Co., The	37
Webster Mfg. Co	24
Webster & Perks Tool Co.	25
Wedderburn & Co., John	Cover
Wells Bros. & Co.	Cover
Weston Engine Co.	40
Wetherill Machine Co., The james P.	27
Whiton Machine Co., D. E.	35
Wiley & Sons, John	23
Wiley & Russell Mfg. Co.	23
Wilkinson & Co., A. J.	32
Wilkinson Co., The	38
Wilson, W. A.	32
Wolverine Motor Works	40
Worcester Machine Screw Co.	27
Wyke & Co., J.	30
Wyman & Gordon	Cover

▲ ▲ ▲

Buyers' Finding List.

Adding Machines.
Grant Calculating Machine Co., Lexington, Mass.

Air Compressors.
Rand Drill Co., New York.

Asbestos Cement Felting.
Johns Mfg. Co., H. W., New York.

Balls, Steel.
Cleveland Machine Screw Co., Cleveland, O.

Bearings, Anti-Friction.
Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg Mfg. Co., Attleboro, Mass.

Belting.
Akron Belting Co., The, Akron, O.

Belt Dressing.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Bicycle Tools.
Bliss, E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Davis & Egan Mach. Tool Co., Cincinnati, O.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
Mossberg Mfg. Co., Attleboro, Mass.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.
Wilkinson Co., The, Chicago, Ill.

(Continued on page 26.)

BUYERS' FINDING LIST—Continued.

Blowers.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Cooke & Co., New York.
Roots, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston, Mass.

Boilers, Steam.
Orr & Sembower, Inc., Reading, Pa.
Sterling Co., The, Chicago, Ill.
Weston Engine Co., Painted Post, N. Y.

Bolt Cutters.
Acme Machinery Co., Cleveland, O
Davis & Egan Machine Tool Co., Cincinnati, O
Dawson & Goodwin, Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa
Strelinger & Co., Chas. A., Detroit, Mich
Webster & Perks Tool Co., Springfield, O.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books.
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Comstock, Wm. T., New York.
Engineering News Pub. Co., New York.
Grant, Geo. B., Lexington, Mass.
Henley & Co., Norman W., New York.
Practical Publishing Co., East Orange, N. J.
Strelinger & Co., Chas. A., Detroit, Mich.
Wiley & Sons, John, New York.

Boring and Turning Mills.
Betts Machine Co., Wilmington, Del.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis & Egan Machine Tool Co., Cincinnati, O.
Niles Tool Works Co., Hamilton, O.
Sellers & Co., Inc., William, Philadelphia, Pa.

Brass Work, Special.
Nolte Brass Co., Springfield, O.

Bushings.
New Process Raw Hide Co., Syracuse, N. Y.

Calipers.
Brown & Sharpe Mfg. Co., Providence, R. I.
Standard Tool Co., Athol, Mass.
Starrett, L. S., Athol, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Wilkinson & Co., A. J., Boston, Mass.

Castings, Brass.
Nolte Brass Co., Springfield, O.

Castings, Iron.
Builders Iron Foundry, Providence, R. I.
Burr & Houston Co., Brooklyn, N. Y
Leland & Faulconer Mfg. Co., Detroit, Mich.
Shriver & Co., T., New York.

Castings, Phosphor Bronze.
Nolte Brass Co., Springfield, O.

Castings, Steel.
Johnson Co., The, Johnstown, Pa.

Centering Drill.
Slocomb & Co., J. T., Providence, R. I.

Chucks, Drill.
Almond, T. R., Brooklyn, N. Y.
Cushman Chuck Co., Hartford, Conn.
Dawson & Goodwin, Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Trump Bros. Machine Co., Wilmington, Del.
Wiley & Russell Mfg. Co., Greenfield, Mass
Whiton Machine Co., D. E., New London, Conn.

Chucks, Lathe.
Cushman Chuck Co., Hartford, Conn.
Dawson & Goodwin, Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn
Horton & Son Co., E., Windsor Locks, Conn.
National Chuck Co., New York.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London Conn.

Chucks, Tapping.
National Chuck Co., New York.

Clutches, Friction.
Evans Friction Cone Co., Boston, Mass.
New Haven Mfg. Co., New Haven, Conn.

Condensers.
Conover Mfg. Co., New York.

Counting Machines.
Durant, W. N., Milwaukee, Wis.

Cranes.
Harrington, Son & Co., E., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Cutting-Off Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., So. Sudbury, Mass.

(Continued on page 27.)

SPEAKING OF LATHES!

We are building them in various sizes from 10 inch to 24 inch swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies.

SEBASTIAN LATHE CO.,
117-119 CULVERT ST., CINCINNATI, OHIO.

A calculating machine will improve the accuracy of any arithmetical work, and also enable the book-keeper, accountant, civil or mechanical engineer, or man of science, to avoid much labor and save some time. There is no room here for a description, but we should like to send you our interesting pamphlet.
Grant Cal Mch Co.
Lexington, Mass.

McFADDEN COMPANY,
TAPS & DIES · VISES · TWIST DRILLS · SLIDE CHUCKS · MACHINE SCREWS · LATHES · FILES · STEEL · TOOL BITS · STUBS
TOOLS
No. 722 Arch St., PHILADELPHIA, PA.

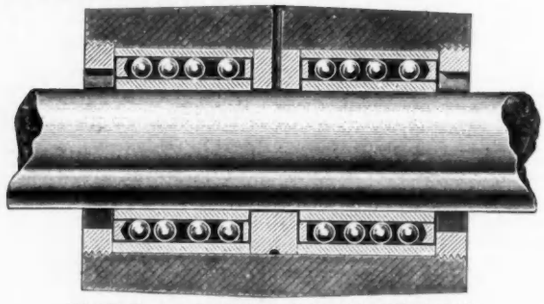
DEALERS IN A FULL LINE OF
Machinists', Mill and Railway Supplies,
15 and 17 South Canal Street, CHICAGO, U. S. A.
MORSE TWIST DRILLS,
KEARNEY & FOOT'S FILES,
WILEY & RUSSELL'S LIGHTNING SCREW PLATES, ETC.
BILLINGS & SPENCER'S WRENCHES, ETC.
SEND FOR CATALOGUE "B."

MACHINISTS' SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEICHTON, SYRACUSE, N. Y.

Patent Carrying Track
OVERHEAD TRAMWAY
for Mills, Foundries, Machine Shops, or for Merchandise. *Send for Book.*
The Coburn Trolley Track Mfg. Co.,
... HOLYOKE, MASS ...

U. S. INJECTORS. GUARANTEED superior to any other Automatic Injector ever before offered in any market in the world. Works with lower steam pressure than any other; works with higher steam pressure than any other. Handles warmer water than any other. Is more perfectly automatic. No higher price.
WRITE FOR CATALOGUE "I."
AMERICAN INJECTOR COMPANY,
312 West Congress Street, Detroit, Mich.

TRADE "HUB" MARK **BALL-BEARINGS**
For General Machine Construction.
ENORMOUS SAVING OF FRICTION AND POWER TRANSMISSION.
RADIAL (CYLINDRICAL) AND END-THRUST TYPES,
FOR STANDARD AND SPECIAL SIZES.



TYPE B, OR DOUBLE RADIAL BEARING.
(For heavy loads and hard service.)

Balls Confined in Cages and Handled as ONE PIECE. No Wear. No Adjustment. No Care. Easily Applied.
No Wear on Either Shaft or Box. Balls Have LATERAL TRAVERSE and Roll Only on Hardened Steel, REMOVABLE SURFACES.
Patented August 19, 1890; April 7, 1891; January 5, 1892; and July 11, 1893.
Caution: Infringement of Patents will be vigorously prosecuted.
Descriptive Circular, with full information, Mailed Free on Application.
THE BALL-BEARING CO.,
Main Office: WATSON STREET, (NEAR NORTHAMPTON.) ... BOSTON, MASS.

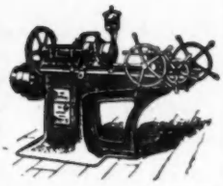
BOLT and NUT MACHINERY.

WRITE FOR CATALOGUE A

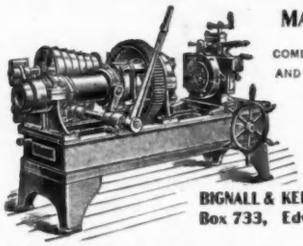
Bolt Cutters, Pointers, Headers, Nut Tappers, Nut Machines, Upsetting and Bending Machinery, Washer Machines, Wire Nail Machinery, Hand and Automatic Spike Machines, Car Link and Pin Machinery.

AND PRICES.

The NATIONAL MACHINERY CO. TIFFIN, OHIO.



"PEERLESS" DUPLEX PIPE THREADING MACHINES.



COMBINATION BENCH AND PIPE VISES.

CONTINUOUS FEED RATCHET DRILL.

BIGNALL & KEELER MFG. CO. Box 733, Edwardsville, Ill.

In Case.

Spring Tempered Rules. One each 1, 2, 3, 4, 6, 9 and 12." 4" Narrow and one center gauge. Sent postpaid until Sept. 1st on receipt of $4.

SAWYER TOOL CO., Athol, Mass.

We Want More Machinery to build; any kind, terms interesting. Write

The J. P. Wetherill Machine Co., Chester, Pa.

$26.50 an 8 Light 16 C P. 110 Volt Dynamo.

This Little Wonder is a high grade machine fully guaranteed. Do your own lighting. Just the thing to light your Shop. Only one horse power required to run it. Sold at above low price to introduce our larger machines.

☞ SEND FOR CIRCULAR NO. 62.

ROTH BROS. & CO. 30 to 34 Market Street, Chicago, Ill, U. S. A.

P. BLAISDELL & CO., Manufacturers of **Machinists' Tools,** WORCESTER, MASS.

Crescent Steel Co.

FORGINGS OF TOOL AND MACHINERY STEEL.

PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.
DENVER, COL.

GOOD, STIFF, SOUND STOCK.

SOFT CASTINGS,

Made from best grades of Pig Iron for Light Machinery, Electric Work, etc.

THE BURR & HOUSTON CO.,

33 to 39 Franklin St., BROOKLYN, N. Y.

Kidd Drill Rods and Needle Wire

Manufactured by the Kidd Steel Wire Co., Ltd., Sharpsburg, Pa.

Superior Quality for all Purposes.

Complete Stocks in Our Warehouses.

ABBOTT, WHEELOCK & COMPANY,

NEW YORK. BOSTON. CHICAGO.

LeCOUNT'S HEAVY STEEL CLAMP

MANUFACTURED BY

WM. G. LeCOUNT,

SUCCESSOR TO C. W. LE COUNT,

South Norwalk, Conn.

Send for "Catalog A." full line of machine tools

SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

STEEL CASTINGS from 10 lbs. upward. Made from best open hearth steel. Also sand rolls and cast-iron pinions. SEND FOR ESTIMATES.

THE JOHNSON COMPANY, Johnstown, Pa.

Lathes 8 to 18 inch Swing.

SEBASTIAN-MAY CO., SIDNEY, OHIO.

SALESMEN WANTED $100 per month and expenses Address with stamp, King Mfg. Co., H31, Chicago.

HENRY CAREY BAIRD & CO.,

INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,

810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

BUYERS' FINDING LIST—Continued.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drawing Instruments, Etc.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffell & Esser Co., New York.

Drilling Compound.
Peerless Drilling Compound Co., The, Utica, N. Y.

Drilling Machines.
Adt & Son, John, New Haven, Conn.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill
Baush & Harris Machine Tool Co., Holyoke, Mass.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Boye, Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Barker & Co., Cleveland, O.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., E., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Montgomery & Co., New York
Mossberg Mfg. Co., Attleboro, Mass.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Quint, A. D., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drill Gage.
Wyke & Co., J., East Boston, Mass.

Drill Rods.
Abbott, Wheelock & Co., Boston, Mass.

Drills, Twist.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Drop Forgings.
Transue & Williams, Alliance, Ohio.
Wyman & Gordon, Worcester, Mass.

Dynamos.
General Electric Co., New York.
Roth Bros. & Co., Chicago, Ill.

Dynamo Brushes.
Wirt, Charles, Philadelphia, Pa.

Electric Machinery.
General Electric Co., New York.

Elevators.
Albro-Clem Elevator Co., Philadelphia, Pa.

Emery Wheels.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Sterling Emery Wheel Co., Tiffin, O.
Strelinger & Co., Chas. A., Detroit, Mich.

Engines, Gas and Gasoline.
Norman Co., J. J., Chicago, Ill.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Springfield Gas Engine Co., Springfield, O.
Webster Manufacturing Co., Chicago, Ill.
Wolverine Motor Works, Grand Rapids, Mich.

Engines, Steam.
Ames Iron Works, Oswego, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Keystone Engine & Mach. Works, Phila., Pa.
Sturtevant Co., B. F., Boston, Mass.
Weston Engine Co., Painted Post, N. Y.
Wetherill Machine Co., James P., Chester, Pa.

Feed Water Heaters and Purifiers.
National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

(Continued on page 28.)

BUYERS' FINDING LIST—Continued.

Files.
Arcade File Works, New York.
Besly & Co., Chas. H., Chicago, Ill.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Strelinger & Co., Chas. A., Detroit, Mich.

Forges.
Buffalo Forge Co, Buffalo, N. Y.
Sturtevant Co, B. F., Boston, Mass.
Wilkinson Co., The, Chicago, Ill.

Friction Cones.
Evans Friction Cone Co., Boston, Mass.

Furnaces.
American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

Gages.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Taylor Rice Engineering Co., Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

Gear Cutters.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J
Grant, Geo. B., Lexington, Mass.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn

Gears.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant, Geo. B., Lexington, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co, T., New York.

Governors.
Replogle Governor Works, The, Akron, O.

Graphite.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grinding and Polishing Machines.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
Norton Emery Wheel Co., Worcester, Mass.
Place Machine Co., George, New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co, Inc., Wm, Philadelphia, Pa.
Strelinger & Co., Chas. A, Detroit, Mich.

Grinders, Center.
Barker & Co, William, Cincinnati, O.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Trump Bros. Machine Co., Wilmington, Del.

Grinding Machine, Cock.
Foote, Barker & Co., Cleveland, O.

Grinding Machine, Cutter.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Foote, Barker & Co., Cleveland, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Grinding Machines, Universal.
Brown & Sharpe Mfg. Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

Hack Saws.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Q & C. Co., Chicago, Ill
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.

Hammers, Drop.
Long & Allstatter Co., Hamilton, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg Mfg Co., Attleboro, Mass.
Stiles & Fladd Press Co., Watertown, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Hammers, Power.
Bremer Machine Co, G. J., Kalamazoo, Mich.

Hoists.
Harrington, Son & Co, E, Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Sellers & Co., Inc., Wm, Philadelphia, Pa.

Hydraulic Machinery.
The Watson-Stillman Co., New York.

Indicators.
Ashcroft Mfg. Co., New York.

Injectors.
American Injector Co., Detroit, Mich.
Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Keyway Cutter.
Baker Bros., Toledo, O.
Mitts & Merrill, Saginaw, Mich.

(Continued on page 29)

NICHOLSON FILE CO.

FREE! Book on Files. 450 ILLUSTRATIONS.

MENTION THIS PAPER.

Do Your Files Wear Out Quickly?
IF SO, TRY
NICHOLSON FILES.
THEY WEAR BETTER AND LAST LONGER THAN ANY OTHERS. THEY COST MORE AT FIRST, BUT
SAVE MONEY IN THE END.

SAMUEL M. NICHOLSON, PRES. AND GEN. MGR.

More sold than of any other Files in the World.

Box 188, PROVIDENCE, R. I., U. S. A.

Automatic Drop Presses

Our Automatic drops are simple, easy to adjust and operate, also capable of rapidly producing work that is uniform, and especially adapted for Stamping or Embossing spoons, forks, medals, name plates, jewelry, and a large variety of metal novelties.

We are prepared to furnish these machines with hammers varying from 50 to 1,000 lbs.

Send six-cent stamp for 1896 Catalogue showing latest improvement in Rolling Mills, Automatic Drops, Power Presses, etc.

PATENTED ROLLER BEARINGS for ALL PURPOSES A SPECIALTY.

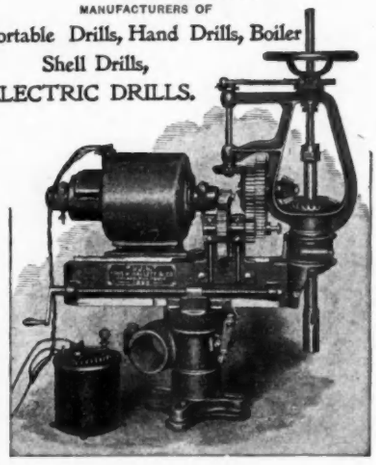
MOSSBERG MFG. CO.,
ATTLEBORO, MASS.

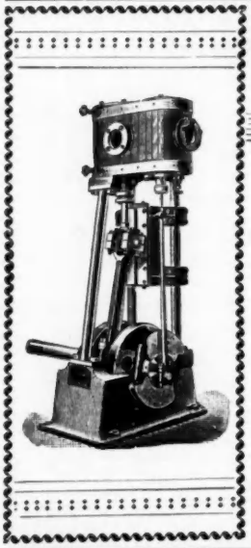
FOREIGN AGENTS:
CHAS. CHURCHILL & CO., London, E. C., and Birmingham, Eng.
KREUTZBERGER, FENWICK FRERES & CO., 21 Rue Martel, Paris, France.

THOS. H. DALLETT & CO.

PHILADELPHIA.

MANUFACTURERS OF
Portable Drills, Hand Drills, Boiler Shell Drills,
ELECTRIC DRILLS.





High-Speed-Engines.

Send for photos, description and estimates.

• • •

W. D. FORBES & CO

HOBOKEN, N. J.

• • •

1302 Hudson Street. Two Blocks from 14th Street Ferry.

The Toledo Machine and Tool Co.

MANUFACTURERS OF

Power Punching, Drop Trimming, Stamping, Riveting, Embossing Presses,

With Automatic Feeds.

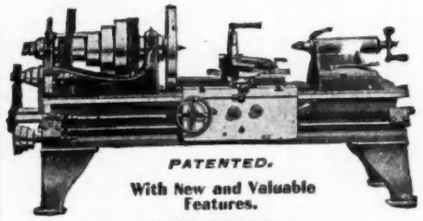
MACHINES FOR WORKING BAR AND SHEET METALS.

Complete Outfits for Can Making.

SEND FOR CATALOGUE A.

The Toledo Machine and Tool Co.
Oak and Jackson Ave., TOLEDO, O., U. S. A.

HIGH CLASS ENGINE LATHES.



PATENTED.
With New and Valuable Features.

MADE ONLY BY
THE BRADFORD MILL COMPANY,
CINCINNATI, OHIO, U. S. A.

Catalogue "A" describes our Lathes, sent on application.

LONDON—Chas. Churchill & Co., Ltd., 21 Cross st., Finsbury.
NEW YORK—Garvin Machine Co., Spring and Varick Sts.

Hangers for Shafting

Send us your specifications of sizes and quantities of Hangers, Pillow Blocks and Post Hangers. Our prices will surprise you—less than cost of manufacture.

COOKE & CO.,
165 Washington St., NEW YORK.
Also Couplings, Shaftings, Wood Pulleys, Belting, etc.

Established 1866.

John Adt & Son,

F. B. Shuster, Prop.

700 to 720 State Street,
New Haven, Conn.,
U. S. A.

. Leading Builders of Automatic Wire Straightening and Cutting Machinery, Automatic Sheet Metal Straightening and Cutting Machinery for straightening and cutting wire and sheet metal to accurate lengths direct from the coil. . . . . .

. Machinery and Tools for the manufacture of Hardware, Bicycle, Sheet Metal, Saddlery and Wire Goods. . Special Automatic Wire and Sheet Metal Forming Machinery. . Blanking, Drawing and Combination Dies. Sub-press Drop and Forming Dies and Tools. . . . . .

Send for Red Catalogue 66.

Special Lot Improved Second-Hand Tools.

VERY LOW PRICES BEFORE REMOVAL.

Reed Lathes, 10 x 4, 14 x 6, 15 x 7 and 24 x 12 ft.
Blaisdell Lathes, 14 x 6 ft., 22 x 12 ft.
Pratt & Whitney Lathes, 16 x 6 ft., 16 x 7 ft.
Pond Lathes, 20 x 15 ft.
Waterman Lathes, 32 x 16 ft.
Fifield Lathes, 32 x 26 ft.

Putnam Planer, 48 in. x 16 ft.
Pond Planer, 32 x 8 ft., 36 x 10 ft.
Hewes & Phil. Planer, 30 x 8 ft.
Draper Planer, 26 x 8 ft.
Pratt & Whitney Planer, 24 x 6 ft.
Fitchburg Planer, 20 x 4 ft.

Warren Universal Radial Drill, 5 ft. arm.
Improved Plain Radial Drill, 3 ft. arm.
Hamilton Upright Drill, 28 in.
Blaisdell Upright Drill, 25 inch.
Snyder Upright Drill, 22 in.
Barnes Friction Sensitive Drill.

Hendey 15 in. Friction Shaper.
Prentiss 16 in. Crank Shaper.
Hendey 24 in. Friction Shaper.
Warren 12 in. Traveling Head Shaper.
Fitchburg 14 in. Traveling Head Shaper.
Pratt & Whitney 14 in. Traveling Head Shaper.

Cincinnati No. 2 Milling Machine.
Lincoln Pattern Milling Machine.
Pratt & Whitney No. 2 Milling Machine, power feed.
Upright Boring and Turning Mill, 37 in.
Hor. Boring, Drilling and Milling Machine, large size.
Stiles Presses, Nos. 2 and 3.
Peck Drop Hammers, 600, 800 lbs.
Gould & Eberhardt 36 in. Gear Cutter.
Boiler Punch, 23 in. Gap.
Boiler Plate Planer, 6 ft. "Niles."
Boiler Bending Rolls, 6, 8, 10 ft.

J. J. McCABE, 14 Dey St., New York.
Successor to E. P. Bullard's N. Y. Machy. Warerooms.

Bargains in New and Second-Hand Machinery.

72 inch, 57 inch, 26 inch and 24 inch Planers, and 36 inch and 50 inch Radial Drills.
48 inch x 18 feet Fitchburg Lathe, modern and triple gear in the head.
4 1-2 inch Pratt & Whitney Cut-off Machine.
7 inch and 12 inch Bement Steam Hammer.
Lathes, Shapers, Drill Presses, Pipe Machines, Bolt Cutters, Steam Hammers, Grinding Machines and General Machinery.
Stock constantly changing. Let me know your wants.
FRANK TOOMEY, 131 North 3d St., Philadelphia, Pa.

MACHINERY BARGAINS....

BEFORE REMOVAL
At Phoenix Iron Works, Trenton, N. J.

10 ft.-16 ft. Vertical Boring and Turning Mill.

29 in. x 13½ ft. Engine Lathe.
26 " 20 " " "
37 " 30 " " "
51 " 18 " " "
19-36 and 50 in. Drills.
Portable Drill.
36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.
Cranes, Blower.

Send for FULL LIST and Prices.

GEORGE PLACE MACHINE CO.
120 BROADWAY,
NEW YORK.

GOOD SECOND-HAND MACHINERY.

ENGINE LATHES.

13 in. x 6 ft., Ames Mfg. Co.
14 in. x 6 ft., Flather & Co.
14 in. x 6 ft., Prentice Bros.
16 in. x 6 ft., Blaisdell.
16 in. x 6 ft., Dexter.
16 in. x 8 ft., Blaisdell.
16 in. x 8 ft., Fitchburg.
18 in. x 10 ft., Blaisdell.
18 in. x 10 ft., Flather.
18 in. x 6 ft., Muller.
21 in. x 8 ft., Lodge & Davis.
20 in. x 16 ft., G. A. Ohl.
33 in. x 16 ft., Ames Mfg. Co.
33 in. x 16 ft., New Haven.
34 in. x 20 ft., Perkins.

PLANERS.

16 in. x 16 in. x 3 ft., Pratt & Whitney.
20 in. x 20 in. x 5 ft., Haywards.
22 in. x 22 in. x 5 ft., H. C. Pease.
24 in. x 24 in. x 8 ft., Fitchburg.
26 in. x 26 in. x 8 ft., D.W. Pond.

SHAPERS.

6 in., Boynton & Plummer.
10 in., Wood & Light, traverse.
10 in., Juengst, crank.
15 in., F. F. Chase, crank.
15 in., Lodge & Davis, crank.

DRILL PRESSES.

10 in., Bench, sensitive.
10 in., Slate, 2 spindle.
No. 2 Garvin, 3-spindle.
3-Spindle Hendey.
No. 2 Pratt & Whitney, 4-spindle.
20 in. Quint Turret Drill.
21 in. Prentice B. G. W. F.
25 in. Pond S. H. W. F.
25 in. Barnes B. G. P. F.
Prentice Bros Suspension.
9 ft. Holly Radial.

SCREW MACHINES.

No. 5 Brown & Sharpe.
No. 2 1-2 Pratt & Whitney.
19 in. x 5 ft., Windsor.
16 in. x 5 ft., Warner & Swasey.

MISCELLANEOUS.

No. 1 Slate Automatic Gear Cutter
No. 1 1-2 P. & W. Hand Miller.
No. 13 Garvin Miller.
1-Spindle Garvin Profiler.
10 in. Diamond Hand Lathes.
12 in. Garvin Hand Lathes.
12 in. x 6 ft. Reid Hand Lathes.
16 in. Square Arbor Fox Lathe.
4 -2 in. P. & W. Cut-off Machine

Write for complete list No. 17, showing a large stock of machinery in addition to this list.

THE GARVIN MACHINE CO.,
Spring and Varick Sts., New York.
Also 51 No. 7th St., Philadelphia, Pa.

SECOND-HAND MACHINERY.

LATHES.

1 13 in. x 4 ft., Ames Eng. Lathe.
1 16 in. x 6 ft., Dustin Eng. Lathe.
3 18 in. x 6 ft., L. & D. Eng. Lathe.
1 19 in. x 6 ft., Fifield Eng. Lathe.
1 20 in. x 11 ft., L. & M. Eng. Lathe with shafting tool rest.
2 21 in. x 10 ft., Pratt & Whitney.
1 23 in. x 10 ft., White Eng. Lathe.
1 27 in. x 10 ft., Dustin Eng. Lathe.
1 27 in. x 12 ft., Wood & Light.
1 28 in. x 12 ft., Wood & Light.
1 28 in. x 16 ft., Eng. Lathe.
1 20 in. Lodge & Shipley, gear blank and pulley tur. and bor.
1 36 in. x 12 ft., Geared Eng., heavy
1 32 in. x 13 ft., B. & D. triple Gd. S. C. comp. rest.
1 40 in. x 16 ft., geared plain turn'g.
1 48 in. x 18 ft., Gay & Silver.

PLANERS.

1 16 in. x 16 in. x 3 ft., Hand.
2 24 in. x 24 in. x 4 ft., Pond.
2 24 in. x 24 in. x 4 ft., W. & L.
1 24 in. x 24 in. x 7 ft., L. & M.
1 28 in. x 28 in. x 8 ft., G. & S.
1 30 in. x 30 in. x 8 ft., S. & S.
1 32 in. x 32 in. x 10 ft., W. & L.
1 32 in. x 10 ft., Open Side.
1 36 in. x 36 in. x 10 ft., New Haven.
1 36 in. x 36 in. x 18 ft., William Sellers.
1 38 in. x 38 in. x 10 ft., Aldrich.
3 48 in. x 32 in. x 6 ft., Pond, with two heads, new pattern.

DRILL PRESSES.

6 Sensitive Bench Drills.
6 Suspension Drills, Pond.
1 19 in. two-spindle Sensitive Drill
1 22 in. back-geared Drill.
1 34 in. back-geared Drill.
1 36 in. Gap Drill, power feed.
1 3-spindle Pratt & Whitney, adj.
2 3-spindle Sensitive, adjble.
1 Quint Turret with tapping attachment, six-spindle.
1 4 ft. arm Radial, Hilles & Jones.

SHAPERS.

1 15 in. Crank.
1 12 in. Traveling Head.
1 9 in. William Sellers, trvg. hd.
1 13 in. Bement & Sons, trvg. hd.
1 12 in. Hewes & Phillips, heavy.

BORING MACHINES.

2 No. 2, Bement & Miles, Hatl.
1 No. 2, Pedrick & Ayer Cyl. Borer.
1 30 in. Stevens Pulley.

SCREW MACHINES.

1 No. 2, Pratt & Whitney, plain.
1 No. 2, P. & W. W. F., Oil Pump.
1 No. 3, P. & W., f. c. hd. bk. g., p. f. to turret slide oil pump.
1 18 in. P. & W., Turret Head Chucking Machine, oil pump.

EMERY GRINDERS.

1 No. 5, Springfield Water Tool Grinder.
1 No. 2, L. & F. Tool Grinder, two wheels.
1 No. 6, Diamond, surfacing att.
1 No. 3, Universal Cutter Grinder.
1 No. 1, Diamond Univsl. Grinder.
1 Brainard Cutter Grinder, on col.
1 P. & W. Forming Tool Grinder.

POWER PRESSES.

1 No. 95, Bliss Double Pitman.
1 No. 4, C. & M., single action.
1 No. 30, Bliss, single action.

MISCELLANEOUS.

2 spindle Profiler; Edging Mach.
1 4 in. H. & R. Cutting-off Mach
10 Bench Vises, various sizes.
1 48 in. Gear Cutter.
1 No. 1, Warner & Swasey Vertical Miller.
1 C. & C. Electric Motor, 50 K. W. Generator.
1 Circular Saw, bench.
Forges, Anvils, Chucks, Drills, Shafting, Pulleys, Reamers and Small Tools.

Send for circular list. Prices on application. Also large stock of new tools.

EASTERN BRANCH, NILES TOOL WORKS CO.
126-128 Liberty St., NEW YORK CITY.

BUYERS' FINDING LIST—Continued.

Lathes (see also Turret Lathes).
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.
Fish Machine Works, H. C., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., E., Philadelphia, Pa.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
New Doty Mfg. Co., Janesville, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark, John, Boston, Mass.

Machinists' Tools and Supplies.
Machinists' Supply Co., Chicago.
Montgomery & Co., New York.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Starrett Co., The L. S., Athol, Mass.

Milling Attachment.
Adams Co., The, Dubuque, Iowa.

Milling Cutters.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Erlandsen, J., New York.
Garvin Machine Co., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Reinecker, J. E., Chemnitz-Gablenz, Germany.
Starrett, L. S., Athol, Mass.

Milling Machines.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

Motors, Electric.
Dallett & Co., Thos. H., Philadelphia, Pa.
General Electric Co., New York.
Roth Bros. & Co., Chicago, Ill.

Needle Wire.
Abbott, Wheelock & Co., Boston, Mass.

Packing.
Jenkins Bros., New York
Johns Mfg. Co., H. W., New York.

Paints, Fire-proof.
Johns Mfg. Co., H. W., New York.

Patent Attorneys.
Bacon, L. Seward, Washington, D. C.
Bates, H. H., Washington, D. C.
Dyer & Driscoll, New York.
Wedderburn & Co., John, Washington, D. C.

Pattern Letters.
Montgomery & Co., New York.
Wells, Heber, New York.

Perforated Metals.
Harrington & King Perforating Co., The, Chicago, Ill.

Phosphor Bronze.
Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

Pipe, Bent.
National Pipe Bending Co., New Haven, Conn.

Pipe and Boiler Coverings.
Johns Mfg Co., H. W., New York.

Pipe Cutting and Threading Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis, Bridgeport, Conn.
Dawson & Goodwin, Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md.
National Machinery Co., Tiffin, O.
Saunders' Sons, D., Yonkers, N. Y.
Wiley & Russell Mfg. Co., Greenfield, Mass.

(Continued on page 30.)

BUYERS' FINDING LIST—Continued.

Pipe Fittings.
Kelly & Jones Co., The, New York.

Planers.
Betts Machine Co., Wilmington, Del.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O
Dawson & Goodwin, Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg Co., New Haven, Conn.
Niles Tool Works Co , Hamilton, O.
Niles Tool Works Co , New York.
Ohio Machine Tool Co., The, Kenton, O.
Pratt & Whitney Co , Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co , Inc., Wm , Philadelphia, Pa.
Wilson, W. A., Rochester, N. Y.

Polishing Wheels.
Builders Iron Foundry, Providence, R. I.

Presses, Dies, Etc.
Adt & Son, John, New Haven, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co , G. J., Kalamazoo, Mich.
Ferracute Machine Co., Bridgeton, N. J.
Mossberg Mfg. Co., Attleboro, Mass.
Stiles & Fladd Press Co., Watertown, N. Y.
Toledo Machine & Tool Co., The, Toledo, O.

Pumping Machinery.
Deane Steam Pump Co., Holyoke, Mass.
Mason Regulator Co., Boston, Mass.
Wetherill Machine Co., James P., Chester, Pa.

Punches and Shears.
Bliss Co , E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Davis & Egan Machine Tool Co., Cincinnati, O.
Long & Allstatter Co., Hamilton, O.
Mossberg Mfg. Co., Attleboro, Mass.
New Doty Mfg. Co., Janesville, Wis.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
W & S. Hydraulic Machinery Works, New York.

Ratchet Drills.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.

Raw Hide.
New Process Raw Hide Co., Syracuse, N. Y.

Reamers.
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Taylor - Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Riveting Machine.
Adt & Son, John, New Haven, Conn.

Rock Drills.
Rand Drill Co , New York.

Rolling Mills.
Mossberg Mfg. Co., Attleboro, Mass.

Rules, Graduated Steel.
Coffin & Leighton, Syracuse, N. Y.
Darling, Brown & Sharpe, Providence, R. I.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Rust Preventing Compound.
Goetze, O., New York.

Saws.
Q. & C. Co., Chicago, Ill.

Sawing Machines, Metal.
Q. & C. Co., Chicago, Ill.

Schools.
Correspondence School of Technology, Cleveland, Ohio.
International Correspondence Schools, Scranton, Pa.
Rose Polytechnic Institute, Terre Haute, Ind.

Screw Machines (see Turret Lathes).

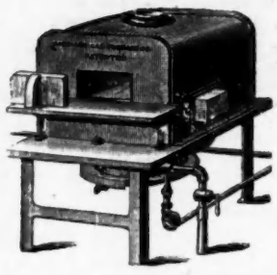
Screws, Machine.
Cleveland Machine Screw Co., Cleveland, O.
Flather & Co., Nashua, N. H.
McFadden Co., Philadelphia, Pa.
Worcester Machine Screw Co., Worcester, Mass.

Screw Plates.
Machinists' Supply Co., Chicago, Ill.
Wells Bros., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wilkinson Co., The, Chicago, Ill.

Screws.
Cleveland Machine Screw Co., Cleveland, O.
Worcester Machine Screw Co., Worcester, Mass.

Separators, Steam.
Keystone Engine and Machine Works, Philadelphia, Pa.

(Continued on Page 31.)



AMERICAN GAS FURNACE CO.,

Oil Gas Plants

GAS BLAST FURNACES AND HIGH PRESSURE BLOWERS

For the economical generation and systematic application of HEAT

CATALOGUES ON APPLICATION.

No. 80 Nassau St., NEW YORK.

English Agency: {Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, London, E. C., England.

STAR LATHES

★ ★ ★

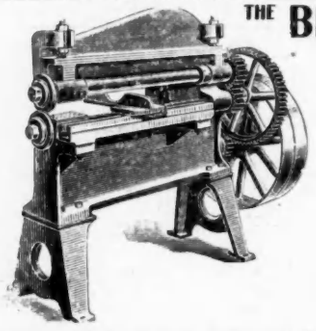
Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.

687 Water St., Seneca Falls, N.Y.

PATENT UNIVERSAL
SCREW-CUTTING
CENTRE, DEPTH, ANGLE, AND TWIST DRILL GAGE
J. WYKE & CO. E. BOSTON MASS. U.S.A.
MFR'S FINE MACHINISTS TOOLS.
FOREIGN AGTS.
CHAS CHURCHILL & CO. CROSS ST. LONDON ENGLAND
SCHUCHARDT & SCHÜTTE, SPANDAUER STRASSE
BERLIN, GERMANY.
SEND FOR LISTS



THE BETHLEHEM ROTARY SHEAR

Or SLITTER

Will Cut Plates one-quarter inch thick or less from one inch to thirty inches from edge—any length.

It will also CUT SHEET METAL in CURVES or CIRCLES

A Low-priced Machine which pays for itself in a few months.

FURTHER PARTICULARS ON APPLICATION.

BETHLEHEM FOUNDRY & MACHINE CO.

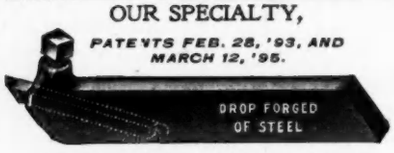
SOUTH BETHLEHEM, PA.

DISCOUNTS Lowest Cash Discounts allowed on Architectural, Scientific, Electrical, Mechanical, Industrial and Technical Books. Catalogue and Discount Sheet Free WM. T. COMSTOCK, 23 Warren St., New York.

PATENTS. HENRY H. BATES, Solicitor, Counselor in Patent Cases. Formerly Examiner-in-Chief, Board of Appeals, U. S. Patent Office. Applications prosecuted. Defences indicated. Correspondence invited. Address, McGILL BUILDING, Washington, D. C.

OUR SPECIALTY,

PATENTS FEB. 28, '93, AND MARCH 12, '95.



ARMSTRONG PATENT TOOL HOLDERS,

FOR TURNING, PLANING AND BORING METALS.

A Full Line

Of Mechanics' Fine Tools, Machinists' Supplies, Bicycle Makers' Supplies.

Material Complete for a High Grade Bicycle, ready to put together, . . . $35.00

You're a mechanic: why not build your own wheel? You save $50.00 and know what you have got.

ARMSTRONG BROS. TOOL CO.,

MANUFACTURERS AND DEALERS Machinists' and Bicycle Makers' Tools and Supplies,

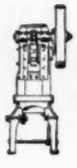
98 W. Washington St., CHICAGO.

One Cent per gallon will cover the expense of making a perfect substitute for "cutting oil" now being used by leading machinists. **PEERLESS DRILLING COMPOUND**

is shipped on trial to responsible parties without expense. Ask for "yard of unsolicited testimonials."

THE PEERLESS DRILLING COMPOUND CO.,

850-52 Genesee St., UTICA, N. Y.



Drop Hammers, Presses, Special Mach'y Dies.

THE STILES & FLADD PRESS CO.,

WATERTOWN, N. Y.

E. W. BLISS Co

1 Adams St., BROOKLYN, N. Y.

CHICAGO: 96 W. Washington St.

DROP FORGING PLANTS.

PRESSES, DIES and SPECIAL MACH'Y

For Bicycle, Electrical and all Sheet Metal Work.

Owners of THE STILES AND PARKER PRESS CO.

SOME DAY, PERHAPS,

—better appliances for Gear cutting than our plant boasts of may transpire. So far, however, they most certainly have not. Our equipment is distinctly modern, and embraces all that the exacting demands of such work requires for cutting Gearing, Spur, Bevel Miter, Spiral, and Worm, up to 50″ diameter and 8-inch face. All our Gears are cut with the "Brown & Sharpe" Patent Involute Cutters, and all are tested on special Gear-testing machines. Perhaps we might even be able to cut the cost of your cut Gearing for you?

LELAND & FAULCONER M'F'G CO.,
DETROIT, MICHIGAN.

CLEVELAND

ESTABLISHED IN 1874.
CLEVELAND TWIST DRILL CO.
99 Reade Street, New York.
85 Queen Victoria Street, London, Eng.
5 Neue Promenade, Berlin, C., Germany.
Cor. Lake and Kirtland Streets, Cleveland, O.

NORTON EMERY WHEEL CO.
SEND FOR CATALOGUE
WORCESTER MASS.

MORSE TWIST DRILL AND MACHINE COMPANY, NEW BEDFORD, MASS.
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills.

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.
Drill Grinding Machines, Milling Cutters and Special Tools to Order.

SAW { WITH THE "FLEETWOOD" and "DEXTER" Foot or Power.
TRUMP BROS. MACHINE CO., Mfrs.
WILMINGTON, DELAWARE, U. S. A.
For sale by CHAS. CHURCHILL & CO., Ltd. London, England.

Car load of Air Compressors for the A. T. & S. F. Ry
RAND DRILL CO., 100 Broadway, New York.

HYATT ROLLER BEARING CO.,
General Office, 450 Market St., NEWARK, N. J.
NEW YORK OFFICE: 133 Liberty Street.
"The wonder is, that this simple yet perfect Bearing was undeveloped and hidden so long."
FLEXIBLE ROLLERS IN STEEL BOXES.

POLISHING WHEELS,
COVERED WITH HEAVY OAK-TANNED LEATHER.
Write for price list with discount, and list of sizes carried in stock.
BUILDERS IRON FOUNDRY,
PROVIDENCE, R. I.

BUYERS' FINDING LIST—Continued.

Shafting, Hangers, Etc.
Pryibil, P., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Shapers.
Betts Machine Co., Wilmington, Del.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Ohio Machine Tool Co., The, Kenton, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Shears, Rotary.
Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

Sight Feed Lubricators.
Kelly & Jones Co., The, New York.

Slotters.
Betts Machine Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Soldering Fluid.
Elliott Chemical Works, Newton, Mass.

Special Machinery.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Toledo Machine & Tool Co., The, Toledo, O.

Steel.
Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.
Johnson Co., The, Johnstown, Pa.
Jones & Co., B. M., Boston, Mass.
McFadden Co., Philadelphia, Pa.

Taps and Dies.
McFadden Co., Philadelphia, Pa.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wilkinson Co., The, Chicago, Ill.

Threading Machines.
Webster & Perks Machine Tool Co., Springfield, O.

Tool Holders.
Armstrong Bros.' Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.

Traveways, Overhead.
Coburn Trolley Track Mfg. Co., Holyoke, Mass.

Tubing, Flexible.
Almond, T. R., Brooklyn, N. Y.

Turret Lathes (Screw Machines).
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Cleveland Machine Screw Co., Cleveland, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey, Cleveland, O.

Valves.
Consolidated Safety Valve Co., New York.
Jenkins Bros., New York.
Kelly & Jones Co., The, New York.

Ventilating Fans.
Backus Water Motor Co., Newark, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant & Co., B. F., Boston, Mass.

Vises.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Hill Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
Niles Tool Works Co., New York.
Place Machine Co., George, New York.
Strelinger & Co., Chas A., Detroit, Mich.
Wilkinson Co., The, Chicago, Ill.
Wyman & Gordon, Worcester, Mass.

Water Motors.
Backus Water Motor Co., Newark, N. J.

Wire Machinery.
Adt & Son, John, New Haven, Conn.
Goodyear, S. W., Waterbury, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Waterbury Machine Co., Waterbury, Conn.

Wire Rope, Iron and Steel.
Trenton Iron Co., The, Trenton, N. J.

Woodworking Machinery.
Barnes Co., W. F. & John, Rockford, Ill.
J. A. Fay & Egan Co., Cincinnati, O.
Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

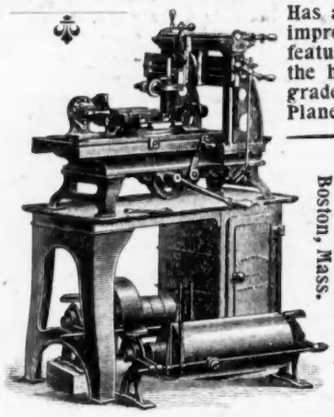
Wrenches.
Machinists' Supply Co., Chicago, Ill

Power or Hand

PLANER

For Model Makers' Experimental Work.

Capable of doing the Best and Finest Work.



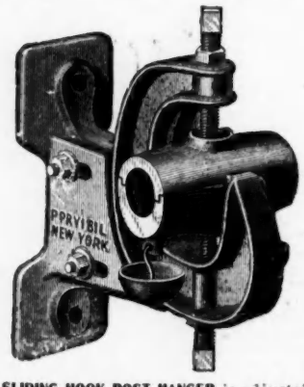
Has all the improved features of the highest grade Planers.

Manufactured by A. J. WILKINSON & CO. 184 Washington St., Boston, Mass.

WILSON IMPROVED IRON PLANERS.
STANDARD SIZES KEPT IN STOCK. By W. A. WILSON RIVER ST. ROCHESTER, N.Y.

SMOOTH BORE HANGERS.

Our boxes are reamed on a special machine which leaves the bearing exceedingly smooth and very accurate. They hold sufficient oil for three to six months. Durability and good workmanship **guaranteed.**



THIS SLIDING HOOK POST HANGER is adjustable in all directions—in and out, up and down. We have it in assorted sizes of diameter and reach. **Hangers of all styles** a specialty. We carry large stocks for immediate shipment. **Don't make hangers. It doesn't pay.** Get our **booklet** and discount and see for yourself.

NEAT DESIGNS. CORRECT PROPORTIONS.
ACCURATE WORKMANSHIP.

◆◆◆

P. PRYIBIL,
512-524 W. 41st Street, New York.
Telegrams, "Pryibil," New York. A B C Code used.

SMOOTH BORE HANGERS.

T. SHRIVER & CO.

333 East 56th Street, N. Y.

Iron and Brass Founders and Machinists

PULLEYS of any size, moulded on machine—no pattern needed.

GEARS of any diameter, face and pitch, made on Gear Moulding Machine—no pattern needed.

How to Save Money in Blacksmith Shops.

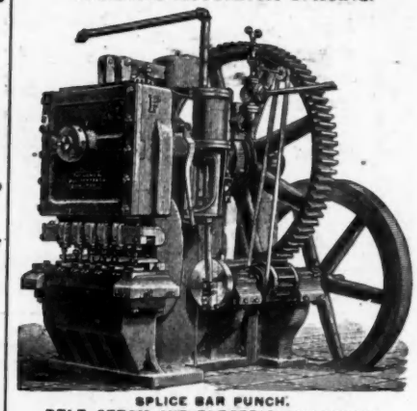
By ORVILLE H. REYNOLDS.

. . . ILLUSTRATED pamphlet showing operations done by dies and formers by means of bulldozer and helve hammers. Ought to be in the hands of every foreman blacksmith. Published by LOCOMOTIVE ENGINEERING, Price 25 cents. 256 Broadway, New York.

The LONG & ALLSTATTER CO.

HAMILTON, OHIO.

DOUBLE, SINGLE, HORIZONTAL, TWIN, MULTIPLE AND AUTOMATIC SPACING.



SPLICE BAR PUNCH.

BELT, STEAM AND ELECTRICALLY DRIVEN

POWER PUNCHES AND SHEARS.

STERLING EMERY WHEEL MFG. CO.

210 THIRD AVE., TIFFIN, O.

ALSO MANUFACTURERS OF

Advance Safety Emery and Corundum Wheels, with or without Wire Web.

The General Electric Co.

The largest Factories using Electric Power employ our Apparatus exclusively.

Motors For driving Machinery of every description.

Dynamos

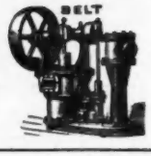
Register your name for forthcoming Book on Electrically-Driven Machinery.

GENERAL ELECTRIC CO., 44 Broad Street, New York City.

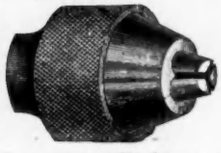
CONOVER'S CONDENSERS

IN STOCK HANDSOME CATALOGUE ON

THE CONOVER MFG. CO. 39 CORTLANDT ST. N.Y.



A Twenty Years' Record!



T. R. ALMOND,

83 WASHINGTON ST.,

BROOKLYN, N. Y.

This chuck has been continuously advertised in the AMERICAN MACHINIST since the first issue of the paper. In spite of imitations, the largest number of sales of the ALMOND DRILL CHUCK were made during the year 1895.

WATER POWER GOVERNED

for electrical and other work, with results equal to the best Corliss engine practice.

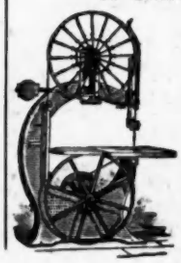
Send for Illustrated Catalogue "A."

THE REPLOGLE GOVERNOR WORKS, Akron, O., U. S. A.
MARK A. REPLOGLE, Chief Engineer.

Monopoly for Sale. Western Brass Founders and Machinists having capital and wishing to extend their business are invited to address **P. O. Box 2064, Boston, Mass.**

WOOD WORKING MACHINERY

OF EVERY DESCRIPTION.

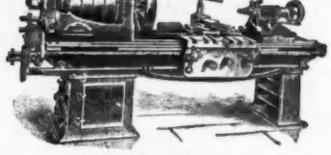


CAR SHOP TOOLS
—AND—
PATTERN MAKERS MACHINERY,
LEADING SPECIALTIES.

Illustrative and Descriptive matter, with prices on application.

J. A. FAY & CO.,
293 to 313 W. Front St.,
Cincinnati, Ohio.

NEW HAVEN MFG. CO. NEW HAVEN, CONN.



Manufacturers of

IRON WORKING MACHINERY,

Planers, Lathes, Slotters, etc.

CATALOGUE AC.